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AND PRODUCTION

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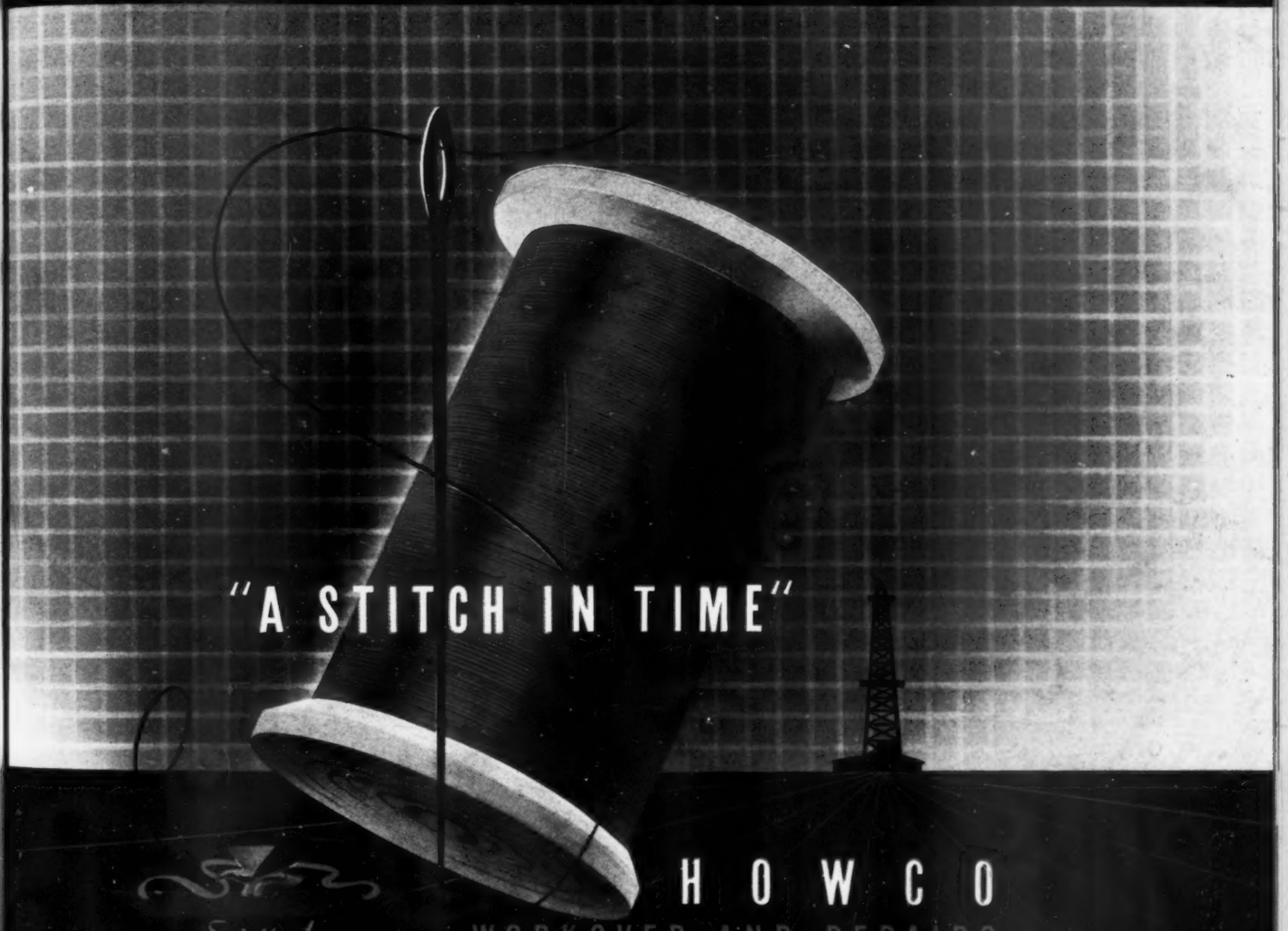
NATURAL GASOLINE



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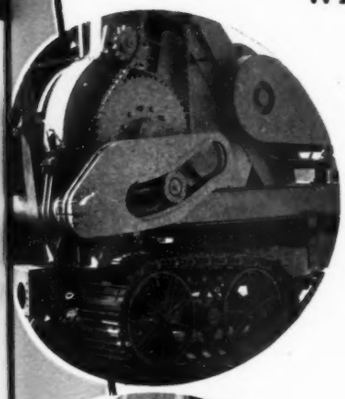

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July, 1942

THE Petroleum Engineer

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MEMBER A. B. C.—A. B. P.

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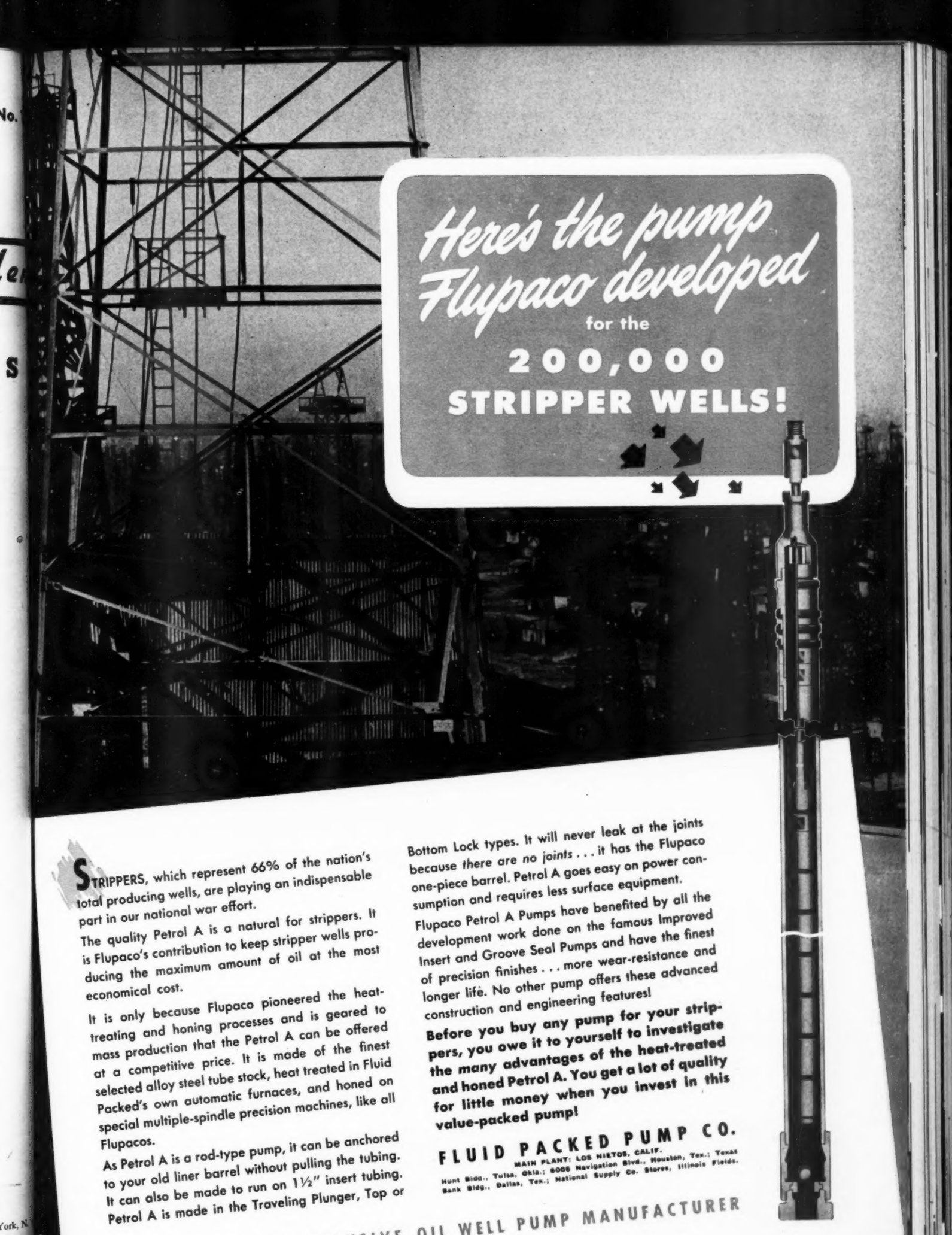

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The Course of Oil

by K. C. SCLATER

PATENTS AND PROGRESS

In his crusade against monopolies and to save the nation from their detrimental effects, Thurman Arnold has extended his attention to patents. He contends that the abuse of patents is a big business monopoly that is preventing industry from using the efficiency of mass production; that it is interfering with the war effort and is hurting the nation's war effort in general. He says that a legislative provision is needed that will prevent the owner of a patent from using it as an instrument of business policy to dominate industry and destroy independent enterprise.

Mr. Arnold discusses the abuse of patents, in the current issue of the *Atlantic Monthly*. Lawrence Langner, an authority on patent law, refutes Arnold's charges and points to the fallacy of Arnold's reasoning in regard to United States patent law and the patent system in general.

One of the most important factors contributing to progress in American industry is the development of patents. Not only our largest, but many of our smallest and most prosperous manufacturers had their beginnings in the exploitation of a patented device or devices. They continue in business year after year manufacturing and improving the device or devices. This is especially true among manufacturers catering to the drilling and producing branch of the industry.

One small business concern manufacturing oil country equipment comes in for mention by Mr. Langner. According to an executive officer of this manufacturing concern, the patent system protects the little man against the large corporation. This is the very antithesis of what Mr. Arnold would have us believe.

It can be truly said for the drilling and producing branch of the industry that much of its progress is founded on the assiduous development and application of patents by specialty manufacturers, who have concentrated their efforts toward improving and applying their devices and so have taken the lead in developing new and more efficient methods and processes.

Any drastic revision of the provisions of the patent law such as Mr. Arnold suggests would be a blow not only to these specialty manufacturers, but to the entire manufacturing industry.

LAGGING OIL RESERVES

The Petroleum Coördinator has recently seen fit to change the title of the office of Director of Conservation to that of Director of the Division of Reserves. For some time now, the matter of new reserves has been of serious concern to officials of the Office of the Petroleum Coördinator—and well it should be. A modification of the existing well-spacing order, especially as it applies to wildcat drilling, may be in the offing, for something must be done to encourage a more vigorous and effective wildcat drilling program. The production committee of the Petroleum Industry War Council has just recommended to that body the abolition of further restrictions on the drilling of exploratory wells. What recommendations will be made by the Petroleum Industry War Council is not known. The need for increasing the oil reserves is imperative, but whether the necessary critical materials will be made available to allow the prosecution of a more active drilling program lies with the War Production Board. It is known that materials are the limiting factor of the nation's production effort. The War Production Board is faced with the task of controlling the flow of materials to the points where they will count most.

Some concern is evident over the rumor that a complete mobilization of all oil industry supplies may be invoked, in which event the overall inventory of the industry's existing supplies would be under one control. The one paramount and controlling consideration in all operations would be their contribution to the war effort. Anything that might result in retarding or vitiating this effort is not likely to be tolerated.

In the matter of abandonments a new policy may also be followed; the abandonment of wells may not be permitted. Further necessary changes may be in store for the industry in order that it can adjust itself and contribute still more to the speeding-up of the war program.

RUBBER PROGRAM ISSUE

Confusion over the government's rubber program stems from conflicting political and business interests. Materials are the key to the nation's productive effort, and that is the only basis on which the rubber question at issue should be viewed. As voiced by Donald Nelson, it is not the simple possession of a formula or a process that guarantees us availability of synthetic rubber or other critical items. War materials can be obtained in greater quantities for the immediate use of our fighting forces from our existing facilities, or materials can be directed from immediate war production to enlarge plant facilities that will increase supplies—but at a later date.

According to Donald Nelson, after a critical appraisal of the many strong competing demands upon the materials at the disposal of the War Production Board, the most urgent needs to be fulfilled were selected and expansion programs were arbitrarily scaled down to a level of reasonable achievement within the time at the War Production Board's disposal. Although many expansion programs were cut substantially, the synthetic rubber program has been left unchanged.

He also stated that because of the shortage of many materials, the decisions to be made are not the easy ones of what supplies we shall increase, but of balancing the need for increasing one at the expense of curtailing another.

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★ **MAXIMUM CAPACITY UTILIZATION** — Petreco users invariably cite capacity increases over a refining unit's rated capacity. No magic is involved; the capacity "increase" simply is due to the fact that many units are designed with ample allowances for expected capacity curtailments due to impurities in the charged crudes. By virtually eliminating the impurities, Petreco Desalting permits maximum capacity utilization.

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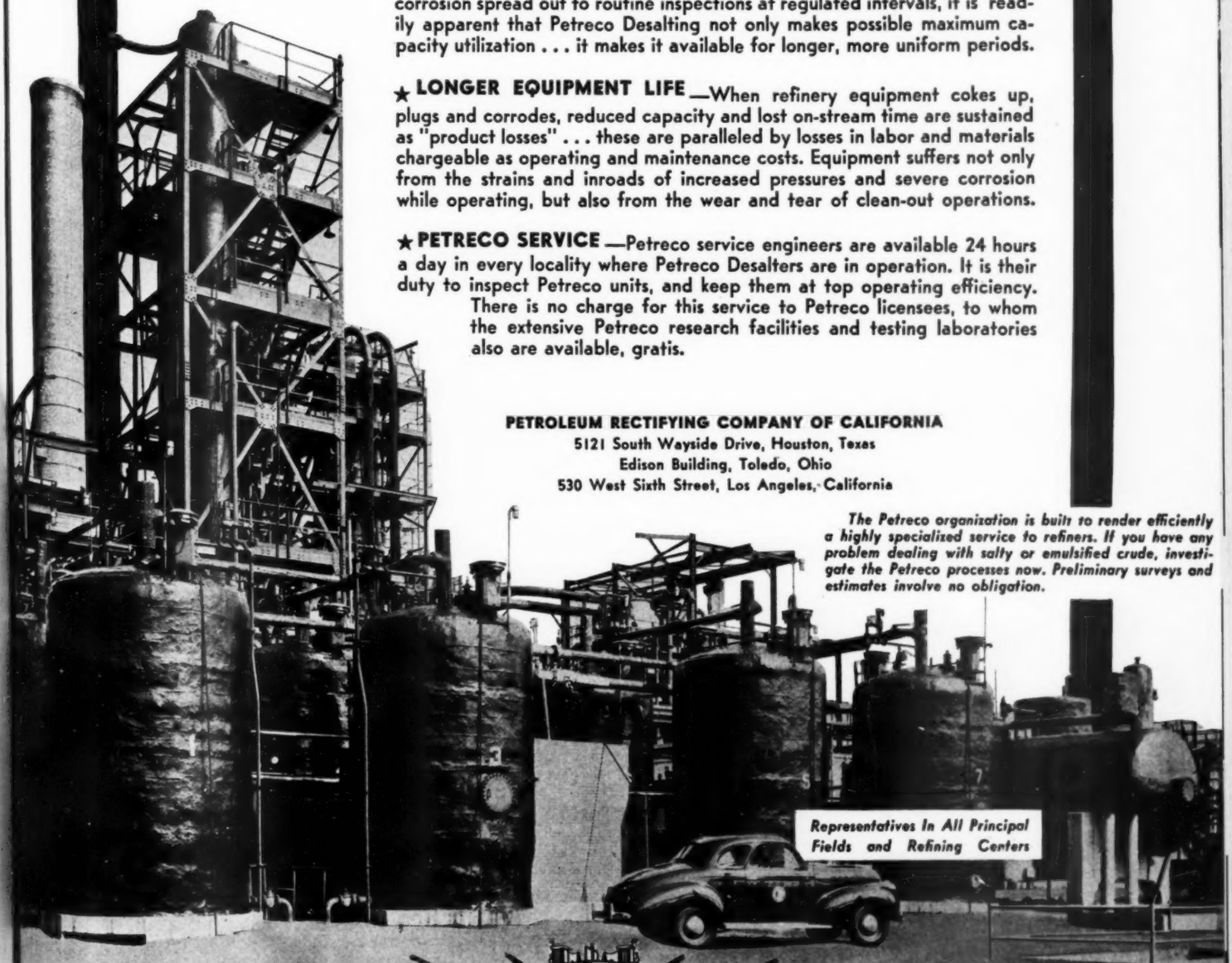

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DESALTING DEHYDRATING

Highlights IN OILDOM

East Texas Pressure Declines

Bottom-hole pressure of East Texas wells declined 6.97 lb. during May, after a sharp three-months' increase. As of June 1, pressure in 99 key wells averaged 1031.51 lb., the Texas Railroad Commission reported. This compared with 1038.48 lb. on May 1, and an all-time low of 1009.73 lb. reached February 1. The pressure decline was attributed to the easing of drastic restrictions on oil production.

"Hot Oil" Law Made Permanent

A bill making permanent the Connally "hot oil" act was signed by President Roosevelt the latter part of June. The legislation, originally passed in 1935 as a temporary measure, forbids interstate shipment of oil produced in violation of state laws.

Originally the bill was drafted to cope specifically with a situation in Texas, putting an end to unrestricted shipping of oil that had been produced in excess of production quotas established by the Texas Railroad Commission.

The law was enacted first for a two-year period. It was extended in 1937 for an additional two years, and then in 1939 for three years. Its terms would have expired June 30 without the present legislation.

Urges U. S. Oil Reserves Off Coast

Senator Theodore G. Bilbo of Mississippi has introduced a bill to assert jurisdiction of the United States over the submerged coastal lands for a distance of 75 miles into the Gulf of Mexico and extending from the mouth of the Mississippi River to the mouth of the Rio Grande on the Texas-Mexico border. He suggests that area be designated as the Gulf Coast Petroleum Reserve No. 1.

A provision of the bill specifically states that the act does not apply to any lands that on the date of enactment are owned by any state of the United States or by any individual, partnership, corporation, or association under the laws of such state. Lands along the Texas Gulf Coast to which the state has proved title thus would not be affected by the new bill should it be enacted.

Change in Meter Order for Cycling Plants

The Texas Railroad Commission on June 29 amended its order of May 19 relative to the use of meters in cycling plants, eliminating the necessity for operators to install a meter on the gas injection line. All other meters as stipulated in the original order must be installed.

Elimination of the injection meter is because, due to war priorities, it is now impossible to obtain the high-pressure meters required for this service.

Oppose Government Control of Refineries

The Gulf Coast Refiners Association, comprising 14 independent petroleum refiners in the Gulf Coast of Texas and Louisiana, went on record at its annual meeting recently as opposing Senate Bill No. S-2562, which apparently authorizes the government to own and operate refineries. The resolution adopted at the meeting follows:

"Resolved that the Gulf Coast Refiners Association be on record as strongly opposed to Senate Bill No. S-2562 because it apparently authorizes government ownership and operation of refineries and other phases of the oil business in which government ownership and operation is not only wholly unnecessary, but would be a detriment to the war effort. Refineries are still producing efficiently all materials for military and civilian use which can be transported. Because of transportation difficulties, many independent refineries are operating at considerably less than capacity, some of them have had to shut down at times, and some are threatened with shut downs. There is nothing to indicate that refineries will not continue to produce adequate supplies of petroleum products for military and civilian uses; nor is there anything to indicate necessity for authority to the federal government to own and operate refineries. So long as refineries are operating efficiently and coöperating wholeheartedly in the war effort, and so long as they are producing, without operating at full capacity, more materials than can be transported, there is no need of authority for government operation and control.

"The only authority the federal government needs to insure efficient refinery operations and adequate supplies of petroleum products for war and civilian uses is authority to compensate refiners for increased costs due to changes in operations, including transportation, to meet war requirements, made under direction of the federal government."

To Increase Helium Production

Helium, that rare and noninflammable gas of which the United States Government possesses a world monopoly, will be produced in greatly increased quantities to meet expanding wartime demands under a program recently inaugurated by the U. S. Bureau of Mines, it is announced by Dr. R. R. Sayers, Director of the Bureau.

Millions of additional cu. ft. of lightweight helium will flow from the Bureau's enlarged helium plant at Amarillo, Texas—the only helium operating plant in the world—Dr. Sayers informed Secretary of the Interior Harold L. Ickes. This helium will be processed from gas produced from Government wells now in operation in Texas. In addition, a new helium production plant at an unannounced location will be supplied with helium-bearing natural gas from an existing pipe line transporting gas for fuel markets, he added.

A new Congressional appropriation of $4,000,000 to be made available from Navy Department funds, will enable the Bureau of Mines to effect the expansion of its helium-producing program and comply with requests of the U. S. Army and Navy for more helium to inflate blimps and barrage balloons and for deep-sea diving. The increased funds also will provide additional helium for medical and scientific uses, of which there are many today.

To date, the Bureau has been able to meet the helium needs of military and civilian establishments through its Amarillo plant, which has been expanded considerably within the last year, Dr. Sayers stated. Under the new program, helium production will be several times greater than that of the past year.

Although restricted by military necessity from announcing specific figures and locations, Dr. Sayers said that plans are being drawn for the construction of the second plant, which will extract helium from natural gas reserves already being operated by a private concern, and that Bureau engineers and geologists are conducting surveys of other fields for helium possibilities.

Practically all helium produced by the Bureau of Mines last year was used for military and governmental purposes, Dr. Sayers said, and the same will be true this year. A considerable part of it will go into blimps on the coastal submarine patrols and for training men for barrage balloon operations to guard cities and areas against airplane attacks.

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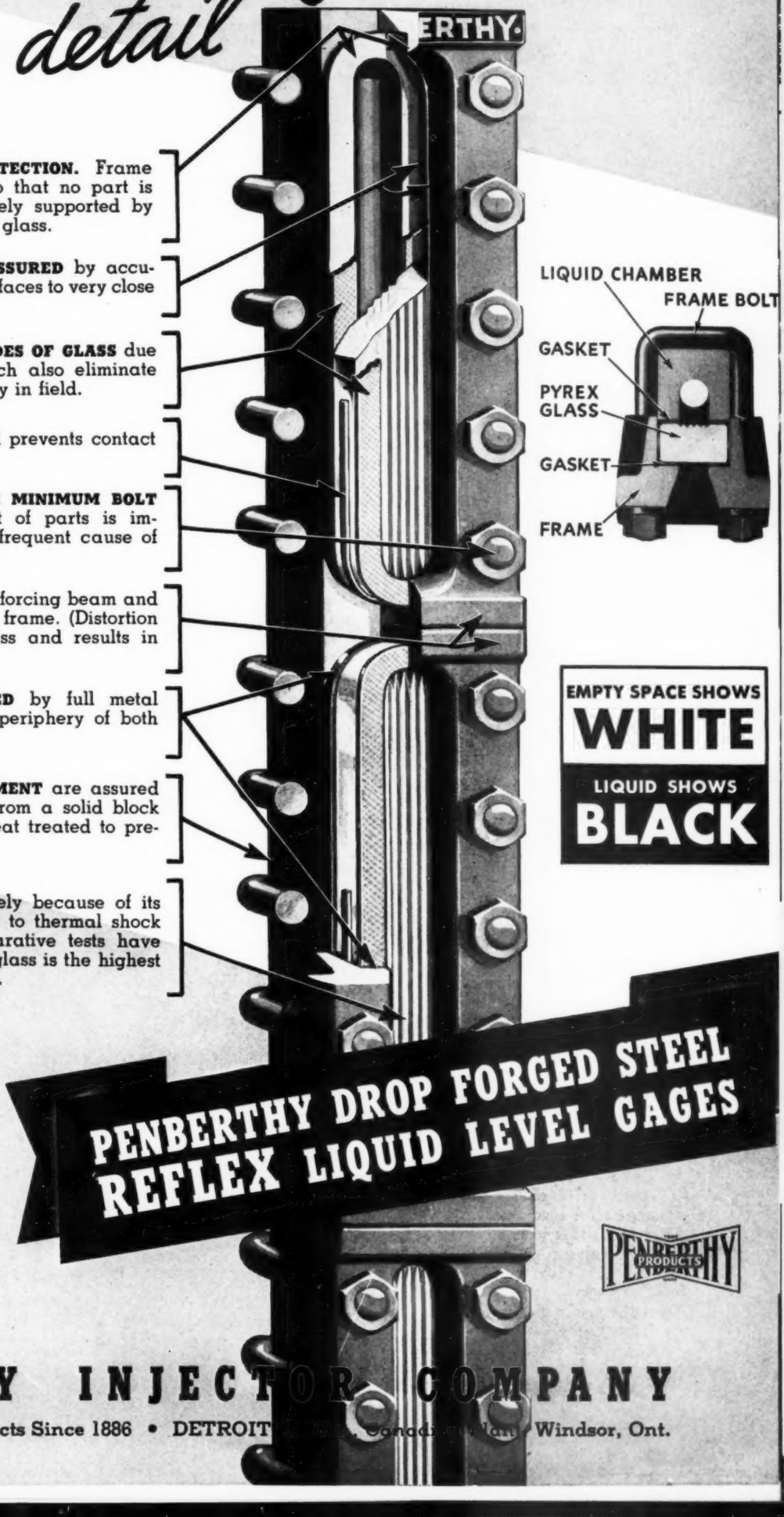

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MAJOR *Refining* ACTIVITIES

SHELL OIL COMPANY, INC., has put into commercial production a new high octane blending synthetic, said to be considerably more effective than any other ingredient in use today, which increases the power of high octane aviation gasolines, according to an announcement by officials.

Certain types of existing plants may be converted over to the production of this essential product in a short time. Conversion of some present refinery facilities to the production of this product has been accomplished in record time. Shell already has one plant producing the synthetic, which required only three weeks to change over, and alterations are under way in another plant to be completed by the end of June.

The promptness of the War Production Board and the Office of the Petroleum Coördinator in granting priorities covering the allocation of necessary materials made possible the quick conversion.

Shell research engineers have been investigating potential ingredients to improve the quality of high octane gasolines, and found that the new chemical has unusual qualities. Additional research has been necessary to establish the operating conditions required for the synthesis of the chemical. The new product was found to have an exceptional anti-knock quality in the super-charged aviation engines, making possible quicker take-offs for the Nation's pursuit and interceptor planes and take-offs with heavier loads in bombers.

The availability of the ingredient is exceptionally important at this time due to the increasing necessity for high octane aviation gasolines. The new chemical not only makes possible production of a more powerful fuel, but at the same time it is possible to produce more aviation gasoline, it is asserted.

Shell is contributing the new technique on the process to the industry through the Office of the Petroleum Coördinator. It is understood that arrangements for the conversion of additional units are being made at the present time.

◆

The board of directors of the Standard Oil Company of Ohio recently approved the $12,000,000 refinery construction program of the company. Some of the projects are now underway. Plans had previously been announced by the company to build an alkylation plant and a catalytic-cracking unit. According to reports, other facilities have been incorporated into the general program, possibly for the production of synthetic rubber components.

◆

Discovery of helium in two southwest Oklahoma gas fields may result in the construction of a helium plant in those areas.

The gas was found in the Cement field of Grady and Caddo counties and in the Carter-Stephens county field. Although the helium content of the gas is not as high as in the Amarillo, Texas, area, it is high enough to interest the government. New funds that have been appropriated for an additional helium plant may be used to extract the gas from the newly discovered field.

A non-selective polymerization plant has been completed and placed in operation at the Bristow, Oklahoma, refinery of The H. F. Wilcox Oil and Gas Company. The catalytic process of The Universal Oil Products Company is used; however, the plant is unusual in that the total gas produced by the cracking plant is processed instead of selecting only the gas from the stabilizer, which is the usual method. The method was adopted in the belief that the plant would lend itself better to the manufacture of aviation base stock or codimer.

According to reports, the results obtained after 30 days of smooth operation of the plant have more than justified the expectation of the company. More than 3 percent yield of the total cracking plant charge is obtained or an increase in total cracked gasoline yield of more than 6 percent. An increase of more than one octane has resulted for the total cracked gasoline. The lead susceptibility of the poly gasoline is high now that the Girbotol treater included in the plant equipment reduces the hydrogen sulphide content in the gas charge from 30 to 10 grains.

◆

State and company officials participated in the dedication ceremonies June 27 of Stanolind Oil and Gas Company's new cycling plant in the South Jennings field, Jefferson Davis Parish, Louisiana.

The capacity of the plant is 50,000,000 cu. ft. a day, the condensate being recovered and the dry gas returned to the producing formation.

◆

Sale of the Continental Refining Company plant, in operation for the last 60 years in Oil City, Pennsylvania, to a newly formed syndicate for an undisclosed sum was announced recently.

The concern had been in receivership for the last six years and the sale was authorized by Judge Lee A. McCracken in an order terminating the receivership.

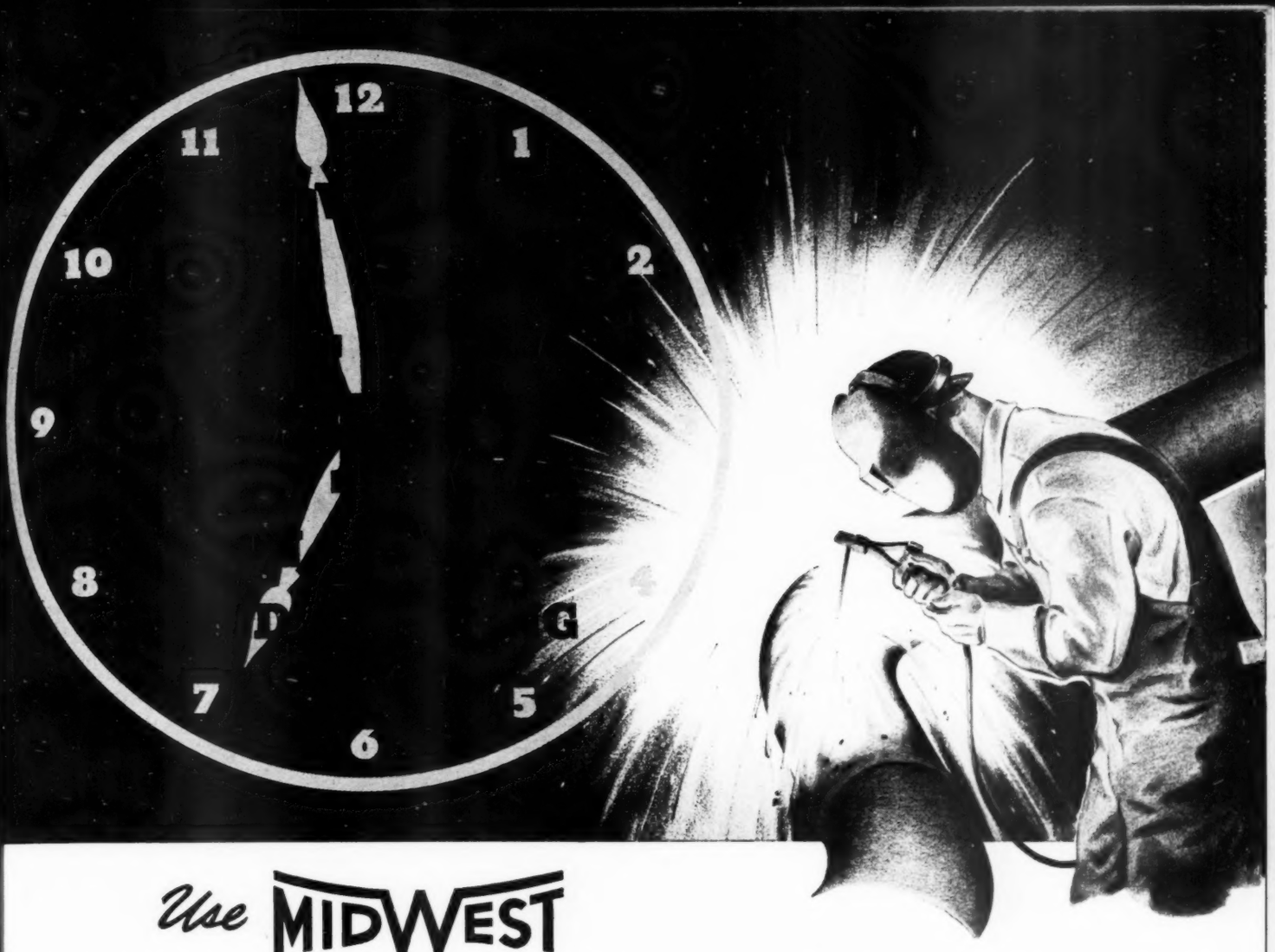
A. B. Weingrad, Butler, Pennsylvania, is president of the new company, which will retain the name of the old company. Weingrad has been prominent in the Pennsylvania oil industry for the last 25 years. T. K. Glenn, Leechburg, Pennsylvania, is vice-president of the reorganized company and Benjamin G. McFate, Oil City, is secretary and treasurer. W. A. Hicks, Pittsburgh, Pennsylvania, has been made a member of the board.

W. J. Anderton, who has been with Continental Refining Company for the last 16 years and who was receiver and general manager during the receivership, will continue his duties. The plant will undergo extensive changes and additions will be made. At present the refinery has a rated capacity of 900 bbl. of crude oil per day and a 200 bbl. per day cracking unit. The plant produces lubricating oil and wax in addition to the conventional range of petroleum products from skimming and cracking operations.

Crude Runs to Stills, Gasoline, Gas and Fuel Oil Stocks
Week Ended June 27, 1942
A.P.I. Figures
(Figures in thousands of bbl. of 42 gal. each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks	Total Gas and Fuel Oil Stocks
(b)*Combined: East Coast, Texas Gulf, Louisiana Gulf, North Louisiana-Arkansas, and Inland Texas	89.7	1,559	65.4	41,567	31,874
Appalachian	84.5	164	94.3	3,067	1,089
Ind., Ill., Ky.	84.9	743	94.8	16,857	6,799
Okla., Kans., Mo.	81.1	370	88.5	8,107	2,879
Rocky Mountain	50.7	93	67.4	2,415	871
California	90.9	652	82.8	16,598	66,643
TOTAL U. S.—B. OF M. BASIS JUNE 27, 1942	86.9	3,581	76.5	(a)88,611	110,155
TOTAL U. S.—B. OF M. BASIS JUNE 20, 1942	86.9	3,434	73.3	89,847	(b)110,562
U. S. B. OF M. BASIS JUNE 28, 1941	.....	3,949	.....	90,414	139,128

(a) Finished, 81,180,000 bbl.; unfinished, 7,431,000 bbl.
(b) Revised, gas oil and distillate fuels upward 40,000 bbl. and residual fuel oil downward 160,000 bbl.; due to correction in figures previously reported by a certain company.
*At the request of the Office of the Petroleum Coordinator.

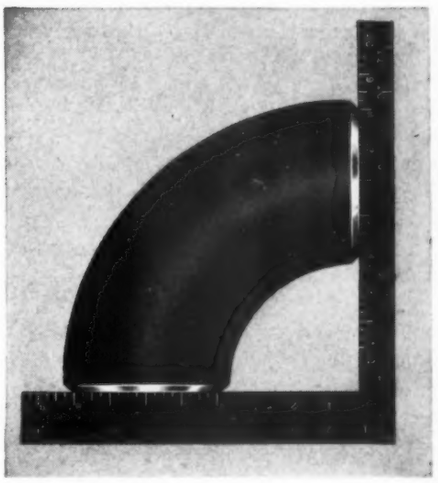


Use MIDWEST
WELDING FITTINGS

Now that "time" is the critical factor on so many welded piping jobs, it is more important than ever before to utilize the time-saving characteristics of Midwest Butt-Welding Elbows.

Qualified pipe welders report that Midwest Elbows save time and trouble on the job because they are always accurately to dimension . . . and because they are always uniform. Time is saved not only in lining up and in welding, but also because all pipe can be cut in advance according to drawings. Another important advantage is that more uniform welds are assured.

These features result from the design and from the unique process used in the manufacture of Midwest Welding Elbows. They are first made slightly oversize . . . then accurately sized in compression at a forging heat. Special fixtures and machine tools assure accurate finishing. Ask for Bulletin WF-41 which gives all the facts.



(above) Exact included angle is the result of special fixtures and tools developed by Midwest for machine-beveling the ends.

(right) Sectional view emphasizes uniform wall thickness and true circular cross-section of all Midwest Welding Elbows (both Standard and "Long Tangent").

MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 So. Second St., St. Louis, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—949 Marquette Bldg. • New York (Eastern Division)—30 Church St. Los Angeles—520 Anderson St. • Houston—229 Shell Bldg. • San Francisco—535 Call Bldg. Tulsa—533 Mayo Bldg.

MIDWEST WELDING FITTINGS SAVE TIME, IMPROVE THE DESIGN, AND REDUCE THE COST OF PIPING SYSTEMS

MAJOR *Oil Field* ACTIVITIES

THE Ohio Oil Company has opened a new Gulf Coast field north of Bay City, Matagorda County, Texas. McDonald No. 1, J. Betts survey, a wildcat well, flowed oil and wash water through a 5/64-in. choke. Casing had been perforated at 8406-08 ft. and had a pressure of 2950 lb. Tubing pressure was 1350 lb.

A prospective pool opener in Lea County, New Mexico, drilled porous and oil-stained dolomitic lime from 4935 ft. to 5019 ft., total depth of the well. Owned by Mascho Oil Company, Midland, Texas, and the American Drilling Corporation, Hobbs, New Mexico, the well is Tide Water-State No. 1, and is in the center of the southwest quarter of the northwest quarter of section 18-12s-35e. Casing in the well is cemented at 4717 ft. The operator plans to acidize the dolomite after completion of natural production tests. The well is the farthest north indicated production in the county.

Superior Oil Company has opened a new South Louisiana pool with its LaTerre Land Company No. 1 in the Jug Lake area, Terrebonne Parish. The well made clean oil on the test at the rate of 162 bbl. of pipe line oil per day on 1/8-in. choke with a tubing pressure of 1800 lb. Gas production was approximately 88,000 cu. ft., which indicated a favorable gas-oil ratio. Perforations were made at 10,220 ft. The well was drilled to a total depth of 13,417 ft., one of the deepest wells in the state. It has been shut in waiting on a State test.

A new producing zone in the Hotulke pool, Oklahoma, has been discovered by the Stanolind Oil and Gas Company with the firm's well Bowling No. 1 being reworked after it was exhausted as a Hunton lime producer. This well was the discovery well of the pool and originally produced 500 bbl. per day. The well was drilled to 4398 ft., total depth, plugged, and 5½-in. casing run to 4365 ft. The well was then acidized with 1000 gal. During an 8-hour test 145 bbl. of fluid was produced, of which 80 bbl. was oil.

Hunt County, Texas, joined the list of oil-producing counties in Texas when Hollandsworth Drilling Company's J. D. Baker No. 1 flowed into open pits during initial testing. The discovery produces from the Woodbine sand at 2778 ft., total depth. The discovery well is located on an 82-acre tract in the Club Lake area about 10 miles southeast of Greenville, Texas, on the Mexia-Talco fault. Twenty-four perforations were shot in the casing from 2761-73 ft., the swell swabbed 1½ hours and then flowed. The crude oil has a gravity of 36.6.

Eddy County, New Mexico, has a new pool opener in Vandagriff No. 1 of Culbertson and Irwin, Inc., Midland, Texas, and Sam Sanders, Artesia, New Mexico. After the plug had been drilled from 5½-in. casing at 3245 ft., the well flowed by heads for four hours at the rate of about four bbl. per hour, but died. Located in the center of the southwest quarter of the northeast quarter of section 6-19s-31e, the well is about 2½ miles southwest of the Shugart area. Production sand was logged from 3326 to 3343 ft. The well was drilled to a total depth of 3570 ft. in lime and was plugged-back to 3343 ft. and shot with 130 quarts of nitroglycerin from 3326 to 3343 ft.

AVERAGE CRUDE OIL PRICES

California		Louisiana	
Kettleman Hills	$1.23-1.29	Rodessa	$ .88-1.20
Playa Del Rey	.80- .87	Gulf Coast	.93-1.36
Coalinga	.73-1.13	North Louisiana	.98-1.30
Wilmington	.68-1.24		
Montana	1.00-1.15	Illinois	1.22-1.37
Wyoming	.45-1.15	Kentucky	1.32-1.43
Colorado	1.05-1.07	Indiana	.85-1.25
New Mexico	.70-1.15	Ohio	
Texas		Lima	1.17
North Central	.97-1.21	Michigan	1.24-1.44
Panhandle	.70-1.12		
West Texas	.80-1.27	Pennsylvania	
Gulf Coast	.93-1.48	Bradford	3.00
Darst Creek	1.14	Southwest	2.65
East Texas	.80-1.27	Eureka	2.59
Talco	.79	Buckeye	2.55
Kansas	.93-1.25	Corning	1.31
Oklahoma	.75-1.25		
Arkansas	.94-1.36		

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in bbl. of 42 gal. each)

	[1]O.P.C. Recommendations June	Week Ended June 27, 1942	Week Ended May 30, 1942	Week Ended June 28, 1941
Oklahoma	436,600	[2]369,300	383,250	420,850
Kansas	281,900	[2]272,100	256,500	237,300
Nebraska	4,100	[2] 3,750	4,000	4,750
Panhandle Texas		107,000	98,000	82,450
North Texas		149,400	155,950	133,050
West Texas		234,450	210,000	264,050
East Central Texas		94,050	100,050	80,600
East Texas		295,000	495,000	373,300
Southwest Texas		163,600	165,950	211,350
Coastal Texas		280,800	324,850	283,450
TOTAL TEXAS	1,068,600	1,324,300	1,549,800	1,428,250
North Louisiana		90,700	86,550	77,350
Coastal Louisiana		220,000	208,150	248,350
TOTAL LA.	311,300	310,700	294,700	325,700
Arkansas	75,300	73,700	72,750	72,700
Mississippi	49,200	[2] 83,500	82,000	28,500
Illinois	320,800	274,900	288,450	339,100
Indiana	18,900	[2] 18,650	21,300	21,300
Eastern (Not incl. Ill. & Ind.)	106,800	98,450	101,000	92,500
Michigan	63,100	65,700	64,400	37,800
Wyoming	96,200	92,150	94,350	77,700
Montana	23,400	22,350	21,700	19,250
Colorado	7,600	7,450	6,350	3,950
New Mexico	80,600	65,150	54,450	111,400
TOTAL EAST OF CALIF.	2,944,400	3,082,150	3,294,000	3,221,050
California	691,900	637,300	583,300	626,200
TOTAL U. S.	3,636,300	3,719,450	3,877,300	3,847,250

[1]O.P.C. recommendations and state allowables represent the production of all petroleum liquids, including crude oil, condensate and natural gas derivatives recovered from oil, condensate and gas fields. Past records of production indicate, however, that certain wells may be incapable of producing the allowables granted, or may be limited by pipe line proration. Actual state production would, under such conditions, prove to be less than the allowables. The Bureau of Mines reported the daily average production of natural gasoline in March 1942, as follows: Oklahoma, 29,200; Kansas, 5,500; Texas, 105,600; Louisiana, 18,500; Arkansas, 2,700; New Mexico, 5,600; California, 39,000; other states, 20,400.

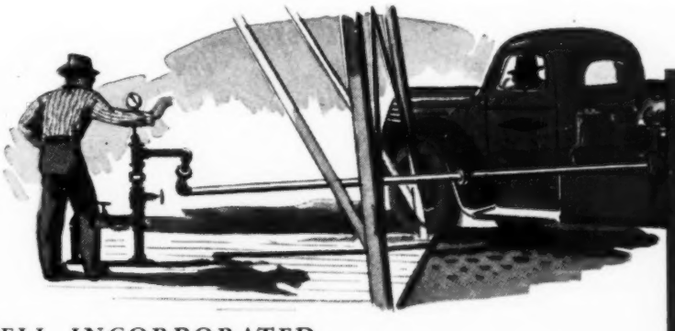
[2]Oklahoma, Kansas, Nebraska, Mississippi, Indiana figures are for week ended 7 a. m., June 24.

OIL IS AMMUNITION! To produce our needed requirements, the productive future of every well must be carefully guarded. . . . Shortages of steel and manpower make this imperative.

The answer, then, is Dowell Reconditioning Service. It is designed to protect and lengthen the productive future of old wells. Thus, it aids in increasing the nation's oil reserves by postponing the time when old wells must be abandoned.

Dowell Reconditioning Service improves the productivity of any type of formation by increasing its permeability through the removal of paraffin deposits and scale accumulations, or by treating the formation itself.

Day by day, hour after hour, Dowell field men are completing *reconditioning* jobs and leaving behind them wells with new productive futures. Because this plan works for others, it will work for you. Let's talk it over—today.



Look to DOWELL

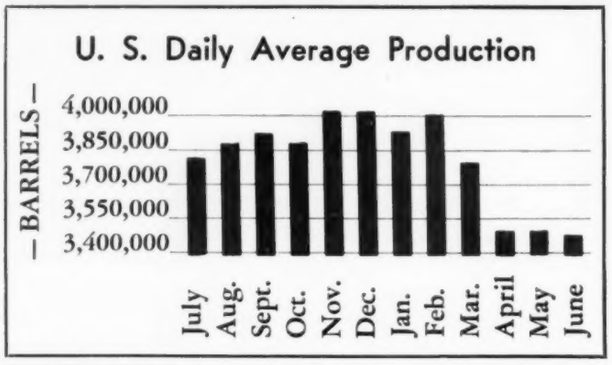
FOR OIL AND GAS WELL CHEMICAL SERVICE

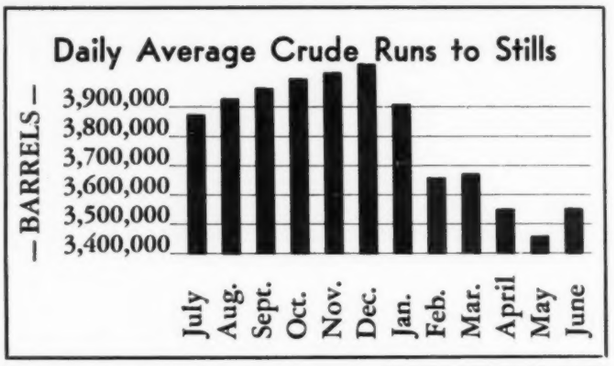
DOWELL INCORPORATED

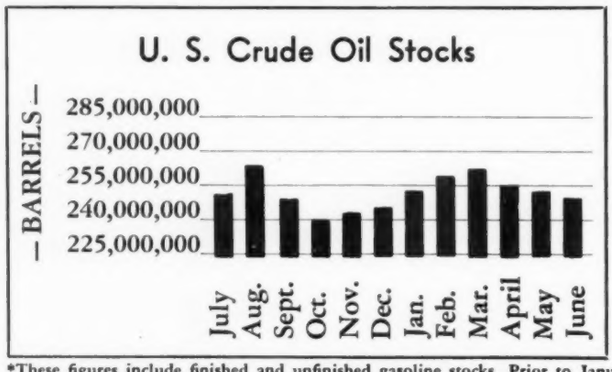
Executive Office: MIDLAND, MICHIGAN—*General Office:* KENNEDY BUILDING, TULSA, OKLAHOMA

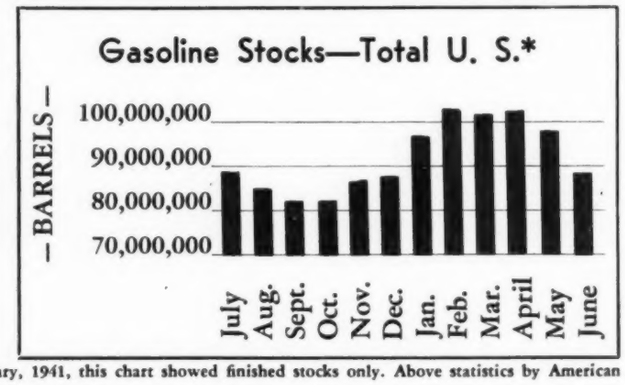
Subsidiary of The Dow Chemical Company

PETROLEUM *Statistics* AND FIELD *Operations*









*These figures include finished and unfinished gasoline stocks. Prior to January, 1941, this chart showed finished stocks only. Above statistics by American Petroleum Institute.

Summarized Operations in Active Fields for June, 1942

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	26	23	5	..	3500-3700	2	40	Rotary
Gaines County	4	3	3	..	4400-5584	2	22-35	Rotary
Hockley County	18	15	2	..	4800-6850	2	20-30	Rotary
Ector County	12	6	4	..	3675-4377	2 or 3	32-36	Rotary
Panhandle	31	27	5	..	1700-3900	2	40	Rot.-Cab.
Nueces County	9	6	6	..	3922-5878	2 or 3	21-54	Rotary
K. M. A. Field	15	11	3	..	3730-3935	2	42-43	Rot.-Cab.
Hawkins Field	16	14	4	..	4495-4912	2	19-29	Rotary
OKLAHOMA								
Okfuskee County	5	3	6	3	2150-4125	2 or 3	38	Rotary
KANSAS								
Russell County	12	9	4	..	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	16	10	7	..	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	15	10	7	..	3290-3518	2	39-42	Rot.-Cab.
ILLINOIS								
Central Illinois	163	158	80	92	1425-4100	2	36-38	Rot.-Cab.
NEW MEXICO								
Lea County	9	6	4	5	3150-4030	2	30-34	Rot.-Cab.
CALIFORNIA								
Kern County	15	8	7	7	1840-11,450	3 or 4	14-30	Rotary
Wilmington	6	3	2	3	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for June, 1942

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1941 (In Barrels)
	June	May	June	May	June	May	June	May	June	May	
Arkansas	12	11	11	6	26	16	10	9	15	12	29,263,000
California	48	37	44	28	55	47	45	42	31	23	230,271,000
Colorado	....	....	....	....	....	....	....	....	....	....	1,792,000
Illinois	163	123	158	65	95	81	80	76	92	85	131,272,000
Indiana	47	41	41	17	42	33	10	6	18	15	6,998,000
Kansas	146	138	127	87	80	74	15	4	32	34	82,733,000
Kentucky	13	11	6	4	7	2	....	....	....	....	4,790,000
Louisiana	152	82	118	61	67	42	14	9	11	13	116,038,000
Michigan	46	52	30	31	56	40	13	11	12	20	16,312,000
Mississippi	11	5	3	0	5	1	....	....	....	....	15,528,000
Montana	14	17	11	15	6	4	3	1	....	....	7,440,000
Nebraska	5	7	4	2	....	....	....	....	....	....	1,785,000
New Mexico	46	41	44	32	25	18	....	....	....	....	39,109,000
New York	71*	75*	71*	75*	18	22	....	....	....	....	5,180,000
Ohio	48	59	41	36	16	18	....	....	....	....	3,342,000
Oklahoma	118	100	109	59	103	90	18	16	88	71	154,817,000
Pennsylvania	153*	169*	150*	164*	36	28	....	....	....	....	16,700,000
Texas	412	369	394	257	530	506	406	398	360	371	501,745,000
West Virginia	47	51	45	44	43	35	14	12	20	21	3,418,000
Wyoming	2	3	1	3	1	3	1	4	1	3	29,952,000
Total	1554	1391	1408	986	1211	1060	629	588	680	668	1,398,485,000

*Includes water-intake and pressure wells.

PETROLEUM ENGINEER EDITION

BAASH ROSS News

BAASH-ROSS TOOL COMPANY, LOS ANGELES, HOUSTON, NEW YORK

A BULLETIN COVERING NEWS OF EQUIPMENT AND OPERATIONS IN THE PETROLEUM INDUSTRY

WHAT *One* KELLY IS TODAY'S BEST BUY?

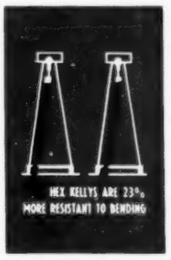
A Frank Answer To The Vital Question—"What Is The Wisest Way To Spend My Kelly Dollar?"

ONE THING this war has done . . . it has made people increasingly aware of the importance of performance and long life in the goods they buy. Today, the man fortunate enough to hold a tire priority certificate isn't wasting it on second grade "price-built" tires. Instead, he's going out of his way—limiting himself in other things, if necessary—to purchase the best constructed, longest-lasting tire he can possibly lay his hands on. He knows that tire may be the last one he'll buy "for the duration" and *performance*, not price, is the only yardstick in which he is interested.

And the same is true in the oil industry. War restrictions on equipment purchases have brought home to oil men the really marked advantages of HEX kellys over conventional types, with the result that more and more operators, faced with purchasing equipment to last for the duration, are turning to hex kellys as the only logical purchase.

Check the advantages you get in a hex kelly point by point, and you'll see why these kellys are playing such an important part in today's equipment programs . . .

▶HEX KELLYS OPERATE SMOOTHER—LENGTHEN EQUIPMENT LIFE! In modern high-speed drilling, balance is an important factor in a kelly. Because hex kellys are *machined* to shape from solid alloy steel stock, they are held to much closer tolerances than possible in the *forged* construction of square kellys. Coupled with their true concentric bore and accurate joint alignment, the result is almost perfect weight distribution . . . and a smoother-running, better balanced kelly at *all* drilling speeds. Smoother running means less vibrational strains on other rig equipment and longer over-all life!



▶HEX KELLYS STAY STRAIGHT LONGER—REQUIRE LESS MAINTENANCE! One of the biggest factors in kelly "mortality" is loss of straightness. Generally, kellys become bent while being swung back in the rat hole . . . or through improper support while being hauled or racked. In either case, *hex kellys are 23.2%* more resistant to these bending stresses than the comparable size of square kelly . . . and stay straight longer under more severe operating conditions.*

Once you have tried Hex Kellys, you'll find, as others have, that the longer kelly life, the lower maintenance costs, the greater rigidity provided by this one feature *alone* are sufficient to justify a complete switch to hex kellys for all your drilling requirements.

▶HEX KELLYS REDUCE STRAIN ON PUMPS! Hex kellys have 48%* more circulation area than comparable size square kellys. That means your pumps can put a *higher* volume of fluid through your string at *lower* working pressures. You not only get *better* circulation, but longer pump life, less pump maintenance as well!

▶HEX KELLYS ARE STRONGER IN TORSION! Since the stress of rotating the entire drill string is concentrated in the kelly, its ability to transmit torque without failure is tremendously important. Because of its shape and greater cross-sectional area, *the hexagonal kelly is 28.6%* stronger in torque than the comparable size square kelly—an important advantage!*

▶HEX KELLYS ARE STRONGER IN TENSION! Besides *rotating* the string, the kelly must also support it . . . and here again the hex kelly has an edge, being 1.8%* *stronger in tension than the comparable size square kelly.*

▶HEX KELLYS CAN BE USED FOR *EVERY* DRILLING REQUIREMENT! When you buy a hex kelly, you're ready for anything. For this is the ONLY kelly that is equally efficient on pressure jobs as well as straight drilling jobs. If it's a hex, ONE kelly is all you need to meet *any* drilling requirement!

Look at the hex kelly from the standpoint of superior performance . . . from the angle of reduction of wear and tear on your other rig equipment . . . from the angle of maximum adaptability to meet ANY situation. In every case, the answer is the same—buy *hex!*

Your nearest Baash-Ross representative will be glad to show you how little it costs, how much it pays, to use Baash-Ross Hexagonal Kellys. Call him . . . or write direct for further information!

*These figures are based on the widely-used 6" square kelly with the 3½" bore vs. the 6⅝" hexagonal kelly with 4½" bore. Because it is the maximum dimension that governs the selection of a kelly size, the 6⅝" hexagonal (across-corner dimension 7¾") is comparable to—in fact, is actually ⅛" *smaller* in its limiting dimension than the 6" square kelly (across-corner dimension 7⅞"). *In other comparable sizes, hex kellys offer proportionate advantages.*

UNDER ALL OPERATING CONDITIONS a Hex kelly is better than a square kelly. But to get the maximum possible efficiency from your hex kelly—and to get longest life and lowest maintenance on your entire rig equipment—drive your hex kelly with a *BAASH-ROSS ROLLER KELLY BUSHING!*

ITS FRICTION-FREE OPERATION permits the smoothest, most accurate and most sensitive kelly feed you can obtain with any bushing . . . at *all* drilling speeds, under *all* conditions. It eliminates jerks, twists and sudden torsional strains in the drilling string, which in turn . . .

1. PROLONGS DRILL PIPE LIFE by reducing twist-off strains and "working" of the joints.

2. GIVES HIGHER BIT EFFICIENCY by maintaining smooth, even bit feed at all times.

3. LENGTHENS ROTARY TABLE LIFE by reducing jerks and damaging impacts on the table bearings.

4. REDUCES SWIVEL WEAR by preventing sudden weight surges against the load-carrying thrust bearing.

5. INCREASES WIRE LINE LIFE by eliminating pounding impacts and tensile surges on the line itself.

LET OUR REPRESENTATIVE give you the full story on this outstanding bushing development. Or write for Bulletin 4 for detailed information!

A NEW EAR GUARD for industrial workers helps prevent fatigue, irritability, and nervous exhaustion due to noisy operations such as found in many phases of the oil industry. It reduces loud noises about 90%, without affecting ability to hear normal sounds and conversation. Increased concentration on work and better efficiency result, according to the report. (No. 510)

BAASH-ROSS

TRUCK TIRE sidewalls are being painted white by one group of oil truckers to increase tire life by preventing careless driving. When rubbed against curbs, etc., the tires tell the story with a "mark" against the driver.

BAASH-ROSS

UNUSUAL TEMPERATURE characteristics in a well can frequently aid in locating water, gas, oil, fluid migration and leaks in casing or tubing, according to a report. This "Thermal Logging" is accomplished by means of a special recording thermometer which produces a temperature record on 16 mm. film, later projected for plotting. The method has been used successfully to find points of oil and gas entry, to trace migrating fluid, and discover holes in casing. (No. 511)

MAJOR *Pipe Line* ACTIVITIES

WAR PRODUCTION BOARD clearance has been obtained for all pipe-line projects formally proposed to date by the oil industry as part of the Office of Petroleum Coordinator's comprehensive seven-project pipe line relocation program, according to an announcement by Petroleum Coordinator Harold L. Ickes.

More than 30 separate undertakings are involved in the seven-project program, in the effort to step-up the movement of oil to the East Coast.

Total cost of the program is estimated in excess of $30,000,000. The projects are being financed by the industry, with new materials for use only in those instances where second-hand pipe, pumping facilities, and other equipment cannot be obtained or employed. It was for the small amount of new materials that WPB clearance was needed.

"If early approval can be obtained for all units on which we propose to go ahead," Coördinator Ickes said, "the entire program can be completed within six months, and in three months a majority of the projects will be in actual operation."

The relocation program as now planned, Deputy Coördinator Ralph K. Davies explained, is designed to increase the flow of crude oil and petroleum products to the Atlantic Seaboard by more than 200,000 bbl. per day. Of this amount, 87,000 bbl. will be moved directly to the East Coast by pipe lines exclusively. The remainder will move initially by pipe line to points on the Mississippi and Ohio rivers and in Illinois and then eastward by tank car and river barge.

Deputy Coördinator Davies summed up the present status of the OPC relocation projects and the separate work items involved in each as follows:

Project One has as its purpose the increasing of crude oil movement from Texas to Illinois and then east by 41,000 bbl. per day, of which 25,000 bbl. will be shipped from Illinois by pipe lines and 16,000 bbl. by lake tankers and rail. All project items have received ratings and work is under way at various points. This project is in three parts and includes the following separate undertakings by the companies enumerated:

Part 1. The Texas Pipe Line Company—conversion and reversal of an 8-in. crude oil pipe line from Port Arthur to Dallas, Texas; installation of pump station at Waxahachie, Texas; laying 110 miles of 10¾-in. and 8⅝-in. pipe lines between Dallas and Stuart, Oklahoma. Stanolind Pipe Line Company—laying 54 miles of 12-in. pipe line between Graford, Texas, and Healdton, Oklahoma; installation of pump station at Devol, Oklahoma.

Part 2. Shell Pipe Line Company—construction of 10-in. pipe line crossing under the South Canadian River between McClain and Cleveland counties, Oklahoma. Stanolind Pipe Line Company — replacement of river crossing (four lines) under North Canadian River in Pottawatomie County, Oklahoma; construction of river crossing under Missouri River. Ajax Pipe Line Company—laying 10 miles of 10-in. loop lines in Missouri. Texas-Empire Pipe Line Company—installation of pumps and replacement of 11 miles of pipe line on Valley Center, Kansas, line; installation of pump stations at Hiattville and Eureka, Kansas; installation of pump station at Centralia, Missouri; laying 32 miles of 12-in. line in Illinois. Stanolind Pipe Line Company—installation of superchargers to increase pumping capacity between Kansas and Illinois.

Part 3. Buckeye Pipe Line Company—installation of pumps at Ellsworth, Mt. Cory and Warren, Ohio. Illinois Pipe Line Company—laying 152 miles of 8-in. pipe line across Ohio. Tuscarora Oil Company—conversion and reversal of gasoline pipe line across Pennsylvania between Negley, Ohio, and Bayway, New Jersey. (The reversal has been accomplished already and the line will be converted to crude oil service as rapidly as possible.) Southern Pipe Line Company—installation of pump stations at York, Pennsylvania, and Hancock, Maryland.

Project Two will increase the movement of finished products through the Plantation Pipe Line between Baton Rouge and Greensboro, North Carolina, by 30,000 bbl. per day. Project rating has been obtained for installation of 14 intermediate pumping stations between Baton Rouge and Greensboro on the line. Application is expected to be submitted in a few days covering construction of 212 miles of 10¾-in. pipe line and 80 miles of 8-in. second-hand pipe line from Beaumont, Texas, to Baton Rouge to supply approximately 60,000 bbl. of products per day to Plantation line.

Project Three is designed to increase pipe line delivery of finished products to the east by 15,000 bbl. a day.

Shell Oil Company has obtained a project rating for a pump station at Muncie, Indiana. Filing of a project application for a products pipe line from Fostoria to Akron, Ohio, depends on future developments in connection with studies of alternative methods of moving products eastward. Project rating has been obtained for reversal of the Susquehanna pipe line between Cleveland, Ohio, and Twin Oaks, Pennsylvania.

Project Four is to increase products pipe line capacity in the east by 32,000 bbl. daily.

The Sinclair Refining Company has obtained project rating for completion of a products line between Marcus Hook, Pennsylvania, and Steubenville, Ohio. This line, as originally planned by the company was to have moved products westward, but instead will move 12,000 bbl. of products per day received by barges and rail to east. Keystone Pipe Line Company has completed the reversal and conversion of the present products line between Pittsburgh and Philadelphia and is delivering 20,000 bbl. of crude oil daily now.

Project Five is to increase pipe line delivery of finished products to the Mississippi River at Helena, Arkansas, by 55,000 bbl. a day, for shipment up the Mississippi and Ohio Rivers by barge to Pittsburgh.

OPC has approved the project application of Gulf Refining Company for reversal and conversion of a present crude line to transport products from Port Arthur, Texas, to El Dorado, Arkansas. Applications are expected soon from The Texas Pipe Line Company for construction of a 15-mile extension of its system from Bossier, Louisiana, to Benton, Louisiana, to connect with the Magnolia pipe line system at Benton Junction, Louisiana, using 8-in. pipe reclaimed from existing lines, and for reversal of the Magnolia crude oil pipe line between Benton Junction and El Dorado; and Project Five Pipe Line Company for construction of a 158-mile products line from El Dorado to Helena, using 10¾-in. pipe reclaimed from existing lines. Project rating has been obtained for the Humble Pipe Line Company covering installation of complete pump stations at Alanreed and Rule, Texas, in order to handle crude now moving through Gulf-Magnolia line from Panhandle to Ranger, Texas, which is now being taken up.

OPC has approved plans for a sixth project involving construction of 220 miles of 8-in. products pipe line across northern Florida, using second-hand pipe excavated in Texas. This will provide additional distributing facilities for the southeast to the extent of 35,000 bbl. per day. This pipe line was proposed by the American Liberty Pipe Line Company.

Still under study is a project for increasing the movement of petroleum products from Longview, Texas, to near Paducah, Kentucky, and then east by 60,000 or more bbl. per day.

THE Petroleum Engineer

JULY, 1942

Multiple-Zone Completions of Oil and Gas Wells

PETROLEUM ENGINEER Exclusive Feature

Dual completions aid in conservation of materials by reducing requirements approximately 50 percent

by E. O. Bennett

Chief Petroleum Engineer, Continental Oil Company

E. O. BENNETT

is a graduate of Stanford University, 1917—He became associated with the Standard Oil Company of California in that year—From 1918 to 1919 he was technical advisor for the U. S. National Advisory Committee for Aeronautics, returning to the staff of Standard in 1919—Was petroleum technologist for the U. S. Bureau of Mines, 1924-26—Chief petroleum engineer for Marland Oil Company, 1926-28—Is now chief petroleum engineer for the Continental Oil Company, with which company he has been affiliated since 1928—This year he was presented the Hanlon Award by the Natural Gasoline Association of America for his work in high-pressure gas and gasoline operations.

THE continued shortage of steel available for the drilling of new wells causes the problem of producing more oil with less steel per barrel of oil to assume greater importance than it has at any time heretofore. In view of the fact that multiple-zone completions have made possible the production of as much oil by one well as previously supplied by two, most states have approved rules and regulations permitting such operations under proper supervision. Such approval has saved enormous quantities of steel that would otherwise have been used in the drilling of duplicate wells. Multiple-zone completions permitting two or more oil or gas zones to be produced simultaneously, or at the discretion of the operator, have saved several million dollars and many thousand tons of steel for war industries at this time.

As an example of the amount of steel saved in a deep field where multiple-zone completions are made between a 9,100- and a 10,300-ft. sand, it is only

necessary to compare the materials required for completion of two wells to separate sands and the material required for a dually completed well to both sands. In this instance the weight of steel needed for the shallower well is 119 tons. This amount of steel will be saved by making a multiple-zone completion of the two producing zones in the one well.

A packer and side-door choke equipment, a negligible weight compared to 119 tons, are the only equipment required in addition to that for a single-zone completion.

The weight of steel saved in a dual completion, as just described, is equivalent to the tonnage required for the construction of four 30-ton army tanks.

Flowing Dual Well

There are two types of multiple-zone completions now in general use: one for flowing wells; the other where both zones are produced by pumping.

In the case of flowing wells, the upper sand is usually produced through the annular space above a packer that seals the space between the tubing and casing, whereas the lower zone below the packer is produced through the tubing. With proper casing and tubing patterns, the areas of the annular space and tubing may be selected so that they are approximately equal and suitable.

Pumping multiple-zone wells has been carried out by a single pump that alternately takes oil from one zone, until its allowable has been made, and then from the second zone. This is accomplished by raising or lowering the pump and tubing so that a perforated section of a flush-joint tail pipe will be either above or below the packer, as desired. Such operations are known as contemporaneous pumping methods and have been carried out very satisfactorily in several fields in Kansas.

Equipment for the simultaneous pumping of two zones has been designed but is not yet in use. It consists of a dual pumping unit that will pump oil from one zone through the tubing and from the other zone through the casing. No shifting of tubing is required for this type of operation. The pumps used may be rod-actuated, electric-motor-driven, or hydraulically operated. They are simple in design, and when used with proper packers, offer an effective means of depleting two-zone completions after the initial flowing stage has passed.

Gas-Lifting in Dual Wells

By the use of two concentric strings of tubing, either one or both of the two zones producing into a single well may be gas-lifted. In this system, gas for lifting purposes may be injected between the two tubing strings. Oil from the lower zone is produced through the inner tubing string and gas from the annular space between the two strings may be injected into it for lifting purposes. Admission of gas may be through small orifices or flow valves. In a similar manner gas from the same source may be injected into the annular space between the outer tubing and casing to assist in lifting oil from the upper zone producing above the packer.

Dual Completions and Pressure Maintenance

Pressure-maintenance operations in connection with flush production from high-pressure fields often require the changing of injection wells because of subsurface conditions. In pools where there are two or more separate sands and gas is being returned for the maintenance of pressure, the use of dual completions is of great value. One well may be used to produce from two zones simultaneously or gas may be injected into the upper zone while oil is produced from the lower. In another case gas may be injected into the lower zone while oil is produced from the upper sand. In still another case both zones may be used for gas injection.

Cleaning Dual Wells

Continued production into the annular space above the packer in a multiple-zone completion often causes the space to become partially filled with fine sand, which may be removed by rapid circulation through a side-door choke such as used in washing-in the well. The choke is installed just above the packer when completing the well, and when circulation down the tubing and out the annular space is desired, a stop is inserted below the side door outlet, after which the outlet is opened. After cleaning out, the stop is removed and the choke closed. Cleaning out the lower zone is accomplished by the usual method.

In event of a difficult cleanout job, it may be necessary to kill the well, pull the tubing and packer, clean-out the well, and rerun the packer and tubing. Even though there may be some difference of pressure between the two zones, there will be no danger of leakage or underground loss between them, as the well will be full of liquid during cleaning operations.

The operation of many multiple-zone completions has indicated that, with proper equipment and care, continuous and economical performance may be anticipated.

Paraffin Removal

When flow in the tubing of a multiple-zone well becomes restricted due to the accumulation of paraffin, any of the present methods of using scrapers or solvents may be used.

If it is anticipated that the casing flow may become restricted by paraffin accumulation, provision should be made for the installation of a second side-door choke on the tubing at a point where the paraffin begins accumulating. This will always be near the top of the well.

When the annular space begins to fill with paraffin, a stop may be inserted in the top side-door choke, the side door opened, and a hot solvent circulated down the tubing and out through the annular space to remove the accumulation. A careful observation of pressures will indicate the beginning of paraffin accumulation.

Formation Pressure Measurement

The formation pressure of the lower zone may be determined at any time by running a pressure bomb through the tubing to the lower zone. The formation pressure of the upper zone may be obtained by running a stop in the lower side-door choke and opening the choke to the annular space.

Advantages

Advantages of multiple-zone completions are:

1. Steel requirements are reduced by half when the zones are closely spaced.

2. Drilling costs are cut in half, as one well is used to produce the allowable normally produced by two.

3. Provides the maximum number of injection locations in pressure-maintenance operations.

4. Approximately 50 percent reduction in the cost of pumping equipment when contemporaneous pumping is carried out for two zones.

5. Saving of time in drilling a new field when conditions suitable for multiple-zone completions exist.

6. Provides increased availability of steel for exploratory development, now that a shortage of steel exists.

7. Reduction in the cost of wellhead equipment per zone.

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Reworking California Oil Wells

PETROLEUM ENGINEER Exclusive Feature

☆ Old wells rehabilitated as means of increasing production of heavy oils with minimum use of steel

by Wallace A. Sawdon
Pacific Coast and Foreign Editor

AN increased demand for heavy oil and restrictions to drilling of new wells to augment the supply of such oil have raised a serious problem in California. Both total production and stocks of heavy oil of 24° A.P.I. gravity and below have declined during the last three years whereas the utilization of residual fuel during that time has increased. Rehabilitation of many old wells will help but the further development of existing fields will be necessary if the rate of productive capacity is to be increased sufficiently to meet present and future requirements. Moreover, exploratory work for new reserves should be done to insure a desired actual production. In the meanwhile methods of producing existing wells have, of course, been altered to increase production from heavy oil fields. Moreover, some operators are working over old wells in order to obtain production that was cased-off without the use of new steel and by this means have been able to increase production to some extent during the last few months.

Changes in Conservation Order M-68 will be necessary, however, if the demand for heavy oil is to be met; and to make definite recommendations for such changes a cöoperative survey was made by the Production Division, District No. 5, Office of the OPC and the oil companies of California. Factual data on the present and future supply of heavy oil were procured by this survey and have been presented in a comprehensive report that not only gives a concise picture of the situation but will serve as a basis for an effective drilling program and for rehabilitation of old wells if the recommendations are followed.

It is estimated that, as of January 1, 1942, the developed reserves of heavy crude oil in California totaled 897,000,000 bbl., or approximately 27 percent of the total state oil reserves of 3,316,000,000 bbl. Since that time the Williams field in the San Joaquin Valley has been discovered with production at approximately 2300 ft. The discovery well penetrated 60 ft. of Miocene sand and had an initial production of 940 bbl. of 16.4° A.P.I. gravity oil; but no estimate of this new reserve has yet been made.

According to the OPC report, it appears that the present rate of productive capacity of heavy oil should be maintained at more than 300,000 bbl. per day but that the normal annual drilling program in the heavy oil fields will not provide a sufficient number of wells to maintain this capacity. The development rate in these fields should

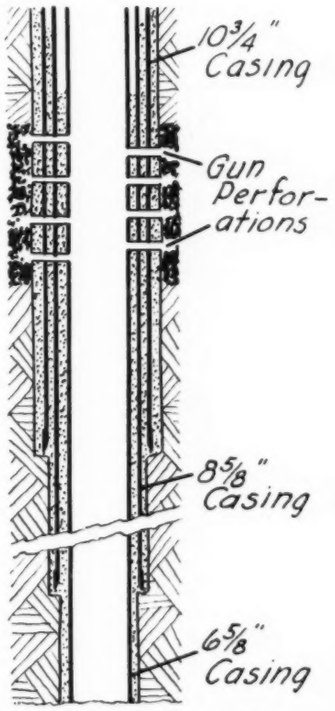

Fig. 1. In this well the shallower production was behind multiple strings of casing

therefore be increased and the report recommends that:

"1. Wildcat drilling be encouraged in every possible way and top primary assistance be given for the drilling of exploratory wells.

"2. All economically producible wells be rehabilitated and equipped where necessary.

"3. The development of undrilled acreage, in fields capable of producing heavy oil, be stimulated to meet the demand made on this most important source of fuel oil."

As the immediate demand for more heavy oil is caused by the war, such oil that cannot be produced within the next few years will be of little value to the present war effort. California heavy oil fields require close spacing to produce a high percentage of recoverable oil in the desired period of time and the report made by the district office of the OPC suggests that old pools with undrilled areas and pools in the primary development stage be drilled with one well to 10 acres, but that the well-spacing pattern provide for secondary development of one well to 5 acres; that undrilled single locations in old pools be drilled according to the uniform spacing already prevailing; and in drilled areas of old pools where closer spacing in justified by the remaining reserves and the steel factor, the spacing for additional drilling be variable to allow for subsurface conditions.

Rehabilitation of Old Wells

There are many wells in California producing heavy oil that can be rehabilitated economically. Some of them need redrilling, others need new casing, and still others need only recompletion in cased-off formations without the use of any new steel below ground. There are, of course, many idle wells that cannot be made into producers economically or without the use of an amount of steel that would be unwarranted at the present time. Most of these wells probably should be abandoned and the casing and other materials salvaged for use elsewhere.

Wells suitable for rehabilitation may be producing or idle. If producing, the increase in production should make the work justified and in all cases the steel factor will have to be decisive at this time even though production obtained by recompletion or work-over is warranted from an economical standpoint. Rehabilitation is, of course, the quickest means of obtaining additional heavy oil production and in most cases will require a relatively small amount of steel. For this reason the reports recommend:

"1. That all applications for exceptions to Conservation Order M-68 covering rehabilitation of shutdown or producing wells be immediately approved provided the steel factor is not less than 1.0 bbl. per day per ton of steel, or 1000 bbl. of 5-year recovery per ton of steel.

"2. That paragraph (c) (1) of Con-

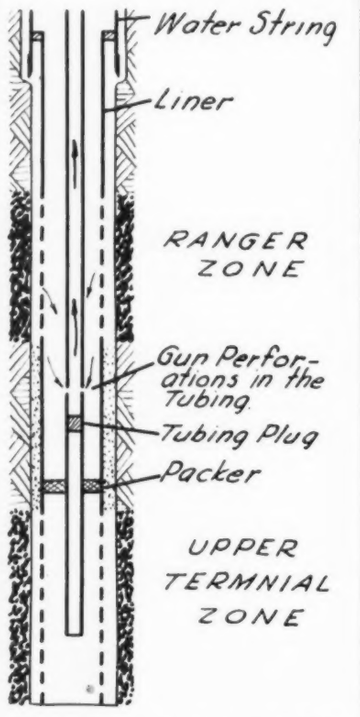

Fig. 2. Indicating the method of recompleting a well by gun-perforating the tubing

servation Order M-68 and paragraph (a) (14) and (a) (15) of Preference Rating Order P-98 be amended or re-interpreted as follows:

"Those provisions relating to replacement, maintenance, and repair be altered so that no application for exception will be required for rehabilitation of existing wells in order to maintain or restore the normal production from such wells, regardless of the bookkeeping methods used in accounting for the cost of such rehabilitation."

Work in California

Although it is hoped that the recommendations of District No. 5 will be given immediate attention and that relief for drilling of new and rehabilitation of old heavy oil wells can be expected, the operators in California are already doing considerable work on old wells that require no new steel. In a few cases deeper, lighter-gravity production is not exhausted, but, due to the demand for heavy oil, a higher zone carrying heavy crude that was cased-off is being put on production.

In some fields most of the older wells were drilled with a particular sand as the objective and upper production was cased-off without knowing it was present. Later drilling of nearby wells disclosed the presence of this upper zone. In the more recently drilled wells the subsurface data obtained while drilling found upper zones that were intentionally cased-off and protected for future use. In determining the depths at which to gun-perforate, the data provided by core records and electric logs are utilized when they are available. In older wells, however, subsurface information is seldom reliable even when records are available. In recent months radioactivity logging has been employed to obtain data on the formations behind casing and from this information the perforating depths are determined.

The shallower heavy oil production frequently lies behind multiple strings of casing and which often are cemented between strings as well as between the outer string and the wall of the hole. An example is the well illustrated by Fig. 1. This well was producing from a lower zone but a sand at a higher level was found in adjacent wells drilled at a later date and was believed to offer good production at this location. A radioactivity log was run and the sand located as indicated. The 6⅝-in., 8⅝-in., and 10¾-in. strings, all cemented, were gun-perforated successfully and a large increase in production obtained.

Although the general procedure of gun-perforating to acquire or control production usually involves the penetrating of one or more strings of casing, the gun-perforation of tubing has also been used to advantage to meet certain requirements. Several wells in the Long Beach Harbor-Wilmington area have been recompleted by perforating the tubing in two-zone wells in order to make more readily available the heavier oil from the Ranger zone for the remainder of its flowing life and for pumping when it ceases to flow. The method used is indicated by Fig. 2.

In these wells the liner has been set through the Ranger and Upper Terminal zones with perforations opposite both zones. The blank section of liner between the zones was cemented. Tubing extended into the Upper Terminal and was packed-off in the liner above this zone so that oil from the Upper Terminal was produced through the tubing and oil from the Ranger flowed up the annulus between the tubing and the liner and casing.

To produce oil from the Ranger zone through the tubing, a plug was set in the tubing above the packer to shut-off the Upper Terminal production and four holes were then gun-perforated in the tubing above the plug. The bullets used with the tubing-size gun perforator were designed so that they would perforate the tubing but not the casing.

A considerable amount of work that does not change the original subsurface structure of the well is also being done in repairing wells producing heavy oil, which is strictly maintenance. For example, the well shown in Fig. 3 in the Wilmington field was originally completed with slotted liner through the Ranger zone. This liner became sanded-up and corroded but did not reduce the flow of oil into the hole. Replacement by a pre-packed gravel liner that would have been advisable if a new liner was to be run would have required killing the well during repair operations and under the flowing conditions of the well this was not desirable. Some old blank liner that was of smaller size and in good enough condition for the purpose was on hand so this was perforated with round holes and was run into the well to position through the original liner. Round holes were used to make sure that the maximum free entry would be provided opposite the slots in the liner left in the well.

It is evident that operators are using their ingenuity in working over old wells without the use of new steel in order to increase present production of heavy oil until relief is granted to allow more extensive rehabilitation operations and the drilling of more wells. Even should permission be given for the use of more steel it appears that more and more work will be done to recover the greatest amount of heavy oil possible by the inexpensive methods that are necessary to make production from many old wells possible from an economic standpoint.

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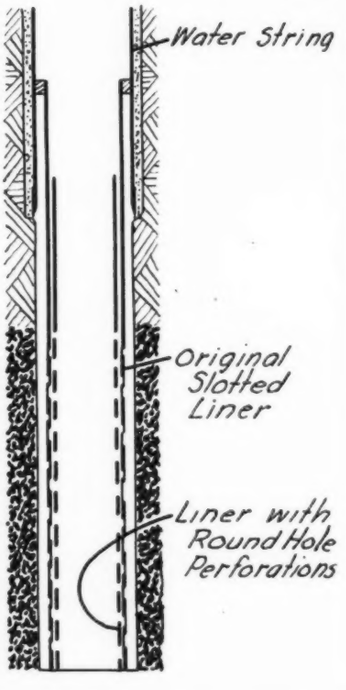
Fig. 3. This well was repaired by running a liner with round perforations inside the original slotted liner



Overcoming Tendency of Packer to Stick in Casing

PETROLEUM ENGINEER Exclusive Feature

☆ Packing element "sweats" own lubrication under high temperature and pressure

by Frank H. Love
Managing Editor

PERHAPS the most troublesome problem connected with the use of packers in oil and gas wells is the tendency of the packing element or sleeve to vulcanize to the casing, caused by high temperatures existing in wells of certain areas. To remove the packer thus stuck frequently develops into a difficult operating problem and almost invariably results in a torn and worthless packing element.

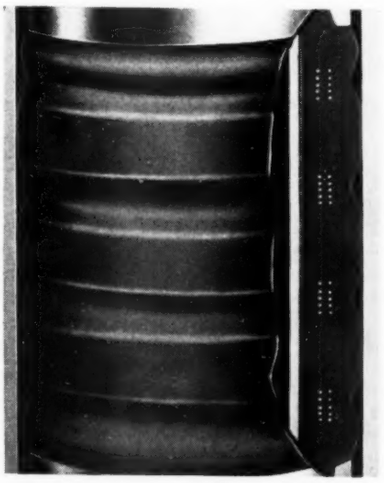


Fig. 1. Illustrating the multiple-ring expansion of the sleeve

To overcome this difficulty and at the same time provide a packer with an effective seal one manufacturer[1] began experimenting 2½ years ago. The result is a lubricant-impregnated packing element. The element is made of neoprene and the lubricant is milled and molded into the construction in such a manner that under heat and load the sleeve "sweats" its own lubrication and prevents vulcanizing to casing even at temperatures as high as 300°F. In time of emergency such as the present, the conservation of vital material and labor and the increased operating efficiency thus effected are factors of no inconsiderable importance.

[1]Merla Tool Corporation, Dallas, Texas.

Metallic Reinforcing

In addition to being lubricant-impregnated, the packing element has internal metallic reinforcing, which imparts added strength and insures multiple-ring expansion for effective pack-off. Fig. 1 illustrates this ring expansion of the sleeve. The metallic reinforcing, which can be seen to the right in the photograph, controls the expansion and at the same time is designed to prevent the sleeve from being stripped or torn off.

In construction, a number of spaced metallic reinforcing wire rings (see Fig. 1) are embedded within the packing element. Each ring includes a series of individual wires, the rings being spaced in vertical alignment with each other. When the packer is lowered into position within the well casing with the packing element in a normal or undistorted position, the slips are moved into gripping engagement with the wall of the casing, holding the slip cone stationary. As the mandrel is slidable through the cone, it moves downward and the confining head being integral with it moves downward also. The downward movement of the head toward the flange of the stationary cone places pressure on the packing element, and, as the wire rings are compressed into closer proximity with each other, the packing element is distorted between each pair of rings into annular protuberances, engaging the casing wall to form a seal. It can be seen in Fig. 1 that the forming of these protuberances has substantially the same sealing effect as a series of superimposed individual packing rings.

The packing element originally was designed for use with gas-lift equipment, as the dry condition of casing in such wells causes excessive sticking. Now the element is also used in deep well completions, for packing-off leaky pipe, in salt-water disposal wells, etc. The sleeve is of a standardized design and is interchangeable for the several types of packer assemblies made by the company.

Field Applications

Application under a variety of field conditions has demonstrated the effectiveness of the lubricant-impregnated packing element even when numerous settings are required. The packer shown in Fig. 2 was run in a 7300-ft. well at Moore, Oklahoma, August 9, 1938, with 7250 ft. of 2½-in. tubing set above it, and was pulled October 18, 1939, thus being in constant service for more than 14 months. Due to the excessive load of tubing on the sleeve, and being set in the expanded position under temperature for so long, the sleeve was about ¼ in. shorter and slightly larger than a new sleeve. It was in such good condition, however, that the operator chose to re-run the packer without replacing the sleeve.

Fig. 2. Packer after use in an Oklahoma well for period of 14 months

Fig. 3. These packing elements were used in three different wells under varying conditions of service

In a well in the Corpus Christi area, a 5½-in. packer was run on a gas-lift intermitter installation that required an accumulation chamber above the packer, the accumulation chamber being larger than the 2-in. production string. The operator did not have facilities for handling the special size pipe of which the chamber was made and to support the chamber, set the packer each time a joint was added. As the chamber consisted of 36 joints, the packer thus was set 36 times, and, after the tubing string was run, the packer was again set to effect a pack-off between the tubing and casing, making a total of 37 times the packing element was expanded against the casing. The condition of the element when removed from the hole may be seen to the left in Fig. 3.

To the right in Fig. 3 may be seen a 5½-in. packer sleeve that saw service as a well-completion packer in a well below 10,000 ft. in the Louisiana Gulf Coast area, where the bottom-hole temperature was extremely high. The packer made an effective pack-off and was retrieved without the sleeve being torn, as may be seen by the illustration.

In another well in the Corpus Christi area a 7-in. packer was run and remained in service for several months. When pulled the packing element showed no effective damage or distortion other than that it took a permanent set caused by the high bottom-hole temperature of the well. (Center in Fig. 3).

The field applications described reveal some of the facts that have been learned from many installations of the packing element made during a period of 2½ years in fields throughout the Mid-Continent area, at depths from 2500 ft. to below 10,000 ft., and in wells of low bottom-hole temperatures and wells of extremely high bottom-hole temperatures. These examples may suggest to operators other uses to which the equipment could be put under similar conditions that would result in more efficient well operation. They also may encourage operators to be less reluctant to change the position of a packer when an improved operating condition is believed possible, knowing that the likelihood of the packing element being destroyed is small.

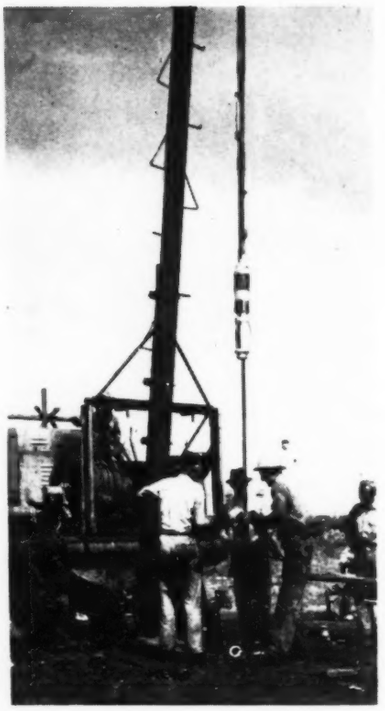


Fig. 4. Running a packer in a West Texas gas-lift well

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P 584.

To Study Production of Motor Fuels from Coal

A far-reaching study of practical and economical methods for producing liquid motor fuels and lubricants from coal will be undertaken by the U. S. Bureau of Mines at Pittsburgh, Pennsylvania, as soon as a new experimental plant just authorized by Congress can be erected and equipped, it has been announced by Dr. R. R. Sayers, Director of the Bureau.

The Fischer-Tropsch method—one of the two direct processes for the production of motor fuels from coal—will be investigated with a view to developing means to produce gasoline from the coals of Alaska and the United States, Dr. Sayers advised Secretary of the Interior Harold L. Ickes. The other method—a modification of the Bergius hydrogenation process—has been studied by Bureau chemists for several years.

This projected research will comprise another Bureau of Mines contribution to the Nation's wartime program for exploring and developing all possible sources of synthetic motor fuel for current emergencies and against the time when natural petroleum reservoirs may be depleted.

Following Congressional approval of the project and the allotment of funds in the 1943 Interior Department appropriation bill, plans were made for construction of the experimental plant adjacent to the Bureau's Central Experiment Station at Pittsburgh. It is proposed by the Bureau to staff the plant with competent chemical engineers and proceed immediately with the business of developing the Fischer-Tropsch process.

The experimental plant will have a capacity of about 100 lb. of gasoline per day and it will include chemical engineering equipment such as catalyst chambers, pumps, charcoal scrubbers, distillation columns, cracking units, and the necessary instruments for control. Future plans call for a pilot plant to handle about 10 tons a day, and also a small plant that can be moved and erected in a short time and at little cost.

The decision to study the Fischer-Tropsch process to produce motor fuels from water gas in the Bureau's program was influenced to a degree by the fact that this process is reported operating on an industrial scale in Europe, especially in Germany, Dr. Sayers said.

Developed since 1926 by Dr. F. Fischer in Germany, the raw material of the Fischer-Tropsch process is a mixture of hydrogen and carbon monoxide gases produced from coal or coke and steam. After removal of sulphur compounds, this mixture is passed over a solid catalyst and the resultant products are propane, butane, gasoline, Diesel fuel, and paraffin wax. About four or five tons of coal will yield a ton of products under present limitations.

So, You Want to be a Petroleum Engineer?

PETROLEUM ENGINEER Exclusive Feature

☆ Part 7 (Concluded)—Bridging the Gap Between College and Industry

by Lester C. Uren

Professor of Petroleum Engineering, University of California

"SO, you're looking for a job? A little uneasy about how to go about it? Don't like to ask favors of people? Nonsense! You're doing them a favor, and if you get the right slant on this business, you'll find it one of the most interesting things you've ever done. Every man has to look for a job now and then—at least once—and don't let anyone cheat you out of the experience. I know, there are probably people who will write letters and others who will give you introductions, but this is one thing you'll want to do 'on your own.' That is, you'll get much more satisfaction out of this first 'job' of yours if you find it yourself; and the people you work with will have more respect for you if some influential relative or friend of the family hasn't 'paved the way.' But first, we must do some planning. We have to decide upon an objective and what kind of work you'd like to do and whom you'd like to work for and where. Of course, you may not be able to have your own way in all these things, but there's no harm in trying.

"First of all, let's be sure we have the right outlook on this business. True, you have a college education behind you; that degree you've been working for these last four years is almost in your hands; and lots of people in the oil industry don't have college degrees, but let's not be too 'cocky' about it. After all, this 'commencement' ceremony you're attending next week is well named. You're only just beginning your professional career. Let's not forget that only a part, perhaps the minor part, of the education of the petroleum engineer can be in the classroom. An important phase of his training must be obtained in industry where he may study actual field operations and equipment. We can acquire something of this during field excursions and tours of industrial observation, but the most satisfactory way is to obtain actual employment in the industry and gain the necessary industrial experience by actual participation in it.

"This contact with industry should begin during the engineering student's undergraduate years, preferably by spending one or more vacation periods in oil field work. Such experience is highly desirable before he enters upon the academic program of his senior year in college, for only with a background of practical field experience can he understand and profit fully from the applied engineering courses of instruction usually provided in the last undergraduate year. Should the student contemplate a graduate course in college, it is usually advisable that a year or more of industrial work should intervene between it and completion of the undergraduate program—a necessary period in which to develop interest in some specialized phase of petroleum industry work that will provide a proper objective for the graduate course. Finally, when the student completes his academic training and enters permanently upon the practice of his profession in the industrial field, his 'practical' training continues through the subsequent years.

"Thus, the education of a petroleum engineer is a continuing, never-ending process. The successful engineer must retain the student viewpoint throughout his professional career, being ever ready to learn from others about him and to profit by the experience gained in his industrial work. Count that day lost that does not contribute something to your store of knowledge; that does not in some way improve your ability to cope with the problems of your chosen profession.

This is the sixth and concluding article in Professor's Uren's present series, under the general title, "So, You Want to be a Petroleum Engineer?". The first article of this series, dealing with, "Considerations in Deciding Upon Petroleum Engineering as a Profession", appeared in the January, 1942, issue. Suggestions on "Planning the College Course" appeared in the February issue, followed by "Getting the Most Out of Your College Course", in the March issue. "Selecting Your Alma Mater" was the topic of the April installment, followed by "Petroleum Engineering Schools of the United States", in the May and June issues.

Selling One's Services

"Seeking employment is essentially a problem in salesmanship. Organizations engaged in the exploitation of oil-field properties need technically trained personnel, just as they need material and equipment or any other essential commodity, and they are frequently 'in the market' for the services of men of suitable qualifications. Petroleum engineers are presumably individuals who have developed such qualifications, some being better equipped than others. It therefore becomes a matter of mutual advantage for the prospective employer and employee to inspect each others' offerings with a view toward an employment commitment. Sometimes it is a 'sellers' market'; qualified men are scarce, and the engineer seeking employment will find it easy to 'market' his services. Usually, however, there is a surplus of technical talent available; so that the employer will be in a position to choose among more applicants than he needs to employ, and in dealing with such a situation, the engineer seeking employment must learn to present his qualifications in the most favorable light.

"The engineering student seeking employment is often troubled with an 'inferiority' complex. He is but a single individual, an outsider with very limited resources and experience, approaching a large, well-established, economically powerful business concern. Those charged with responsibility for employment of new personnel are difficult of approach and appear to be critical and exacting in their requirements, and many young men are reluctant to subject themselves to such a situation. The young man seeking employment should remember always that the prospective employer is usually just as anxious to recruit capable men for his organization as he, the applicant, is to find employment; that he is offering for sale a valuable commodity — his services — worth more to the prospective purchaser than to the vendor, for if this were not so, the employer would not find it profitable to offer employment.

"Selling one's services can be made an interesting, pleasurable experience by making a game of it. Study your opponent—the employer or his representative who has charge of selection of new employees, and plan your sales campaign accordingly. What qualifications will be of interest to him? How will he respond to this or that 'approach'? We are all amateurs when we

begin to play this 'game,' but skill may be cultivated in this as in all other things. And what game can be more important and profitable than that which offers the means of advancing toward the goal of one's professional career?

Planning the "Approach"

"The young man seeking employment will do well to consider the factors that make for a favorable impression on those with whom he must deal. If a letter of application is to be prepared, particular care should be taken that it is in good business form, aptly phrased, correctly spelled and punctuated; that it is not too long and yet contains the essential information that an employer seeking a new employee would wish to have. Such a letter might appropriately be accompanied by a supplemental page containing detailed personal data and a photograph of the writer. Suitable references should be given to responsible persons who would be willing to write supporting letters of recommendation. Letters of recommendation are more effective if they are confidential and sent directly by the writers to the person to whom they are addressed. 'Gladhand,' open letters that the candidate himself presents, are usually discounted by the recipient.

"If the candidate for employment is granted a personal interview by a representative of the prospective employer, he should give consideration to such matters as dress, habits of speech, mannerisms, and other factors that have a bearing on the impression created on the interviewer. Don't simply 'drop in' and ask for an interview. Seek an appointment in advance, at a time convenient for the person whom you wish to see. And be punctual in keeping it if the interview is granted.

"Most employers of engineering personnel are interested in finding men who have facility in report writing. A well-written thesis or technical paper that the candidate may leave for inspection as a sample of his work will help to create a favorable impression. Good drafting and careful technique in assembling graphs and tabulated data are always appreciated by an engineering executive.

"In anticipation of the eventual competition for employment, the enterprising engineering student may plan years in advance to develop personal attributes and a record of attainment that will make him attractive in the eyes of a prospective employer. To work toward such a goal, one must have ever before him as objectives the things that the employer looks for and desires in his employees. What factors make one individual seem more desirable than another in this job seeking competition? Much has been said and written on this subject, but there is obviously no general agreement, because employers are not all alike and do not themselves agree on what they want when they hire a petroleum engineer. Nearly all agree, however, that certain things have significance in characterizing the men most likely to develop into useful employees.

"An important criterion, of course, is the student's scholarship record. Other things being equal, the student with the better scholarship record would be preferred. The man with a poor scholarship record has failed to make a success of his college 'job;' and if he has been unsuccessful in this, it is not likely that he will be overly successful in his later industrial job, unless he has unusual qualifications of another kind that would off-set his scholarship deficiency. It cannot be denied that the average of all of the grades assigned by the many instructors who have had opportunity to appraise a student's performance during his college course has significance as an index of his ability, especially as a measure of his mental capacity and general intelligence. There is ample statistical information indicating that in general the student with a good scholarship record in college has a better chance of succeeding in his later professional career than the one with a poor record. Yet, one may be a brilliant student and achieve an outstanding scholarship record but lack that practical understanding and ability that enables him successfully to apply what he knows.

"No one can maintain that scholarship is a measure of all factors that make for success in a professional engineering career, or even that it is the most important factor. Certain personal characteristics must also be taken into account, some of which are intangible and difficult of appraisal. Several years ago, a committee of the American Council on Education, in conference with a group of prominent industrial leaders, attempted to define the personal qualifications in an individual that are important in determining his success in industry. It was the considered judgment of this committee that the successful industrialist must be a person of good character; he should like to work; he should possess initiative; he should have good judgment; he should be able to get along with and work with others; he should be healthy; he should have a pleasant appearance and manner; he should have a vocational objective and ambition to attain it, and he should be prepared to accept social and community responsibilities. To these, one might add leadership, energy, reliability, accuracy, speed, etc., but it is not easy to say whether these are in themselves fundamental traits or the expression of other personal attributes.

"How can we appraise the intangible factors that underlie what we call 'character?' What constitutes a 'pleasant appearance and manner?' What is 'good judgment?' Obviously, some of these things are relative and can not be quantitatively evaluated. Individuals possess them in varying degree. Yet, they are characteristics that have definite meaning, and in most cases they can be cultivated or developed in the individual by education and training. Some employers believe that they are measured by the student's success in extracurricular activities where he has come into competition with his fellows.

"Many administrators agree that good judgment, a pleasing personality, and ability to work with others are most important among the desirable personal characteristics. Initiative and willingness to assume responsibility, also, are essential after one has reached a certain stage in his professional development. Most employers are seeking the well-balanced individual: the person who has all or most of these desirable characteristics uniformly developed. The engineering student will find it profitable to take stock of his personal attributes, and if he finds himself deficient in any of these things, should strive to remedy the deficiency by suitable means. It must be confessed that some things like health, personal appearance, intelligence, and liking for work are not readily altered and seem to be more or less inherent in the individual.

Recruiting Administrative Personnel

"The recruiting of technically trained manpower with which to conduct its producing operations is a continuing problem in every oil company organization. The business success of an industrial organization depends to an important degree upon the character and ability of the men who manage it. But 'turnover' is a factor in management personnel as well as in other divisions of labor, and every successful business concern must ever be seeking and training qualified men capable of promotion into the higher administrative positions. A well-planned system of training within the organization will be of great assistance in developing competent future management personnel, but much depends on the original selection of the men who are to receive this training. Employment of technically trained personnel for sub-

ordinate positions is thus usually conducted with a view toward finding men who possess qualifications that would enable them, after further training, to advance eventually into responsible administrative positions. Large oil-producing companies are always interested in and usually ready to employ young technically trained men who offer such promise. It is often more difficult for the oil-producing company to find and develop technical personnel than it is for the individual to find employment.

"Usually the large oil company centralizes its employment problems in a personnel department, presided over by a personnel officer. He, or an assistant, interviews and classifies all candidates for employment. Such an organization systematizes the procedure of assembling data relative to qualifications of applicants and permits utilization of scientific principles to the problem of selection. The applicant for employment is usually asked to supply answers to an elaborate questionnaire designed to provide a complete case history of his family background, education, work experience, health record, and other pertinent data. For certain types of employment, the applicant may be required to pass a written test designed to measure the responsiveness of his mental processes. A physical examination by a medical officer may also be required. Stress is placed on a character analysis of the candidate, resulting from an interview with a representative of the personnel department. Frequently, in seeking employment in an engineering department of an oil company, the prospective employee will also be referred for an interview to the head of the department in which he is to work.

"The personnel department maintains offices at company headquarters, perhaps with branch offices in employment centers near the oil fields or refineries. People seeking employment are expected to apply at these personnel offices. Competition for superior talent among young men about to graduate from the universities and colleges is so keen, however, that some of the oil companies make a practice of sending personnel department representatives to the principal technical schools of the region in which they operate to recruit promising personnel for their organizations. Usually, they are interested in procuring the services of only the outstanding members of the graduating class: students who, on the basis of scholarship records and personality appraisals, will rank among the highest fifth of their class. The advice of teachers who have had personal contact with candidates is often sought in the process of appraisal.

Have You an Objective?

"The engineering graduate seeking employment should have a well-defined objective in view: a particular position or type of work he eventually wishes to achieve, but he should not be too particular as to the route by which he may eventually attain it. He must be willing to start in a 'routine,' subordinate capacity and follow toward his objective, whatever path may be in his employer's best interests. The initial salary and rate of advancement should be of less concern than the experience offered. The young engineering graduate must realize that he is not an engineer in the eyes of his employer until he has served his apprenticeship in the practical phases of the industry and has demonstrated his ability to apply what he knows in a practical way.

"Few employers are willing to place a young, inexperienced man in responsible charge of important work until there has been apportunity to become personally acquainted with him and he has demonstrated his ability in some subordinate capacity. Often the initial employment offered the engineering student will be 'roustabout' work, which may include cutting weeds, digging ditches, loading and trucking supplies and equipment, and other routine labor assignments. The young man who is physically underdeveloped or who is unaccustomed to working with his hands may have difficulty in competing with 'seasoned' workers in such 'chores.' Often such work is given the new employee as a means of observing his response to hard physical work at menial tasks. Perhaps he is given such things to do merely to give him an opportunity to adjust himself to new surroundings before assuming more exacting tasks, or until work more in keeping with his attainments is available. The engineering student may be assured that the employer is just as anxious as he is to take full advantage of each employee's capabilities and training. If routine labor tasks are to be performed, the employer can usually find better equipped and more productive laborers to do the work than young engineers. If he chooses to use higher talents of an employee in such work, it is usually for some definite purpose, such as giving opportunity for certain types of experience, or to test the response of an individual to disagreeable tasks. The engineering student will do well to undertake such assignments cheerfully and to give them his best efforts. Indeed, 'roustabout' work offers a greater variety of contacts and opportunity for observation of field operations than many of the more specialized and restricted occupations.

Keeping the Student Viewpoint

"The engineering apprentice should welcome changes in his assignments, for every change in occupation brings new experiences, and his remuneration during the early years of his professional career should be measured largely in terms of experience. He should focus his entire effort during these early years on that important opportunity that is likely to come his way five or ten years after graduation from college. The intervening years should be directed primarily toward the objective of acquiring training and experience that will make him most capable of meeting the obligations of this important opportunity when it arrives.

"Some of the larger oil companies conduct 'trainee' or apprentice programs especially planned to give young engineering graduates a variety of practical training in the routine aspects of oil-field exploitation. Such a program usually contemplates moving the individual through a succession of assignments in the different departments of the field organization, leaving him in each for a sufficient time for him to become thoroughly familiar with the work of the department and the individuals employed in it. The program sometimes extends over two or more years and involves perhaps six or eight different assignments. Often a program of lectures and study accompanies the field training. Trainees may be shifted from one field or region to another so that they will not be provincial in their training. After completion of the training program, the trainee will perhaps be considered ready for a permanent assignment in whatever phase of the work he may be most interested or best qualified. He is paid whatever wage may regularly attach to the work that he is currently doing; or by agreement, in view of his apprentice status, he may receive something less than the usual wage.

"Such a plan possesses advantages, both from the standpoint of the individual and the employing company. For the individual, it provides a maximum of varied experience and contact with personnel of all categories throughout the organization. It affords the administrative officials of the company an opportunity to study the personal characteristics and capabilities of the trainees, so that they may later be fitted into the organization in positions where they will be most useful. It is unfortunate that the selection of graduating engineering students for trainee courses is usually restricted to but a small group of the superior candidates and that the great majority of engineering students entering the industry must seek their experience and training

by the slower and more orthodox methods.

Plan Your Own Career

"Much of the foregoing discussion may suggest that the petroleum engineering student seeking his opportunity in industry must be a victim of chance; that he must work where and as he can find employment, and that his opportunities are likely to be determined by decisions entirely in the hands of others.

This, of course, is true in large part, yet there is room in such a system for the individual to shape his own future and to a certain degree work in whatever way he may prefer toward his own professional objectives. Indeed, every engineering graduate should have his own well-conceived and developed plan of industrial development; and with sufficient determination and perseverence, almost any plan that the individual may map out for himself may be achieved.

"For example, within limits determined by employment opportunities, the graduating engineering student may decide the region or locality in which he prefers to work. He may, for a time, deliberately seek Gulf Coast experience or California experience. He may plan at the earliest opportunity to seek work in some foreign country. He may have a strong preference for experience in the production phase rather than the development phase of the industry. He may prefer to work for a small company or one of moderate size, rather than a large company. For personal reasons, he may wish to work for some particular company.

"The individual's future happiness in his job and satisfaction in his work may depend very largely upon the conditions of his employment, and the prospective employee would do well to 'look over' his prospective employer carefully before he makes application for employment. Does the company enjoy a good business reputation? Has it been successful over a period of years in meeting its financial obligations and in earning proper dividends? Is there a moderate labor turnover? Are its employee relations satisfactory: are the employees loyal? What has been the company's policy relative to promotions and salary increases? Is the management enterprising? Is it 'technically minded' and progressive in its adoption of modern methods? Is expansion of current activities likely?

"The graduate petroleum engineer should give careful consideration to the type of company that he might prefer as an employer. Small and moderate sized concerns usually offer their engineering personnel a wider variety of occupational experience, perhaps with better opportunity for rapid promotion. On the other hand, they are less stable, and employment tenure may be less dependable. The large oil company, on the other hand, usually offers assurance of life-time tenure, though promotions and salary increments may be slow. Large organizations usually trend toward specialized services, so that each individual must confine his activity within a narrow sphere. The large company often offers the better opportunity for experience inasmuch as the junior engineers have the privilege of working under the guidance of senior engineers of long and perhaps highly specialized training. In the small organization, on the other hand, there are comparatively few engineering employees, and there is less opportunity for the young engineer to learn from others.

"Many young men in college look forward after graduation to work abroad, giving opportunity for travel and living for a time in a foreign country. Several of the larger American oil companies have foreign operations, and it is sometimes possible for engineers in their employ to be assigned to work in one of their foreign subsidiaries. Usually, however, the companies are unwilling to do this until the young engineer has had a year or two of experience in their organization in this country. South America is a region in which many petroleum engineering students have lately been interested. Those looking forward to oil-industry employment in this part of the world are advised to study and obtain a command of the Spanish language. Foreign assignments are often on the basis of three-year contracts. One may either go to some foreign country with the idea of staying there and 'growing up with the industry' or contemplate return to the United States after one or two three-year 'tours.' It is often difficult to arrange transfer back to the 'home' organization without sacrifice of position, salary, and seniority, however. Though the individual is likely to have more responsibility thrust upon him in a foreign assignment, as a rule he must live and work under more primitive, perhaps less healthful, conditions, and it is doubtful whether the industrial experience is as good as that obtainable in a modern, well-equipped, and scientifically operated field in the United States.

"The young engineer would probably profit most during his early years of training, by seeking employment in the more active fields where development work is under way. A routine existence in some older, settled field, where methods are standardized and equipment changes are few, is not conducive to technologic advancement. A deliberate move from one region to another to offset provincial tendencies and gain variety of experience is sometimes advisable. A change in employers means sacrifice of seniority rights but will permit the apprentice-engineer to gain wider experience in the practices of different companies. 'Rolling stones' may not gather 'moss,' but they acquire polish.

"The importance of having a well-defined objective can not be overemphasized. Unless one knows what he is working for, planning is futile. An engineering education provides a basis for at least three different types of work. Thus, there are engineers engaged in research and development work; another group is engaged in planning and designing applications of the results of research and development work in industry, whereas, a third group is engaged in the operation of engineering enterprises. Perhaps we might add a fourth type of engineering service that appeals to some: that of 'sales engineering.' Petroleum engineering graduates may find employment in oil-company field or headquarters organizations, in research laboratories, in oil-field service organizations, and on the sales staffs of oil-industry equipment manufacturers. Each type of service, each kind of occupation requires a somewhat different outlook and preparation, and the engineering student should try to determine as early as possible the type of work in which he would be most interested and for which he is temperamentally best adapted.

"It has taken some time and a good many words to discuss this problem of the academic foundations of the petroleum engineer and the closely related problem of erecting on these foundations, the beginnings of a successful industrial career. You must admit, there are many 'angles' to consider; that one cannot hope to be a successful petroleum engineer without first providing a broad, substantial foundation that will adequately support the superstructure over our 'well' of achievement, no matter how deep it may go. Look well to these foundations, lest they fail at some critical time in your future 'development program.' We may not fully appraise the stresses that will be imposed, the strains that will develop in the superstructure, but if the foundations are adequate, and our design is well conceived, we may look forward with confidence to the ultimate 'completion' of a successful professional career. May your 'productivity index' be high, your 'decline curve' flat, and your 'ultimate' all that you now hope for. How 'deep' are you?"

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PETROLEUM ENGINEER Exclusive Feature

Refinery Practice for the Operating Man

Vocational Class Proceedings in Refinery Engineering

Manufacture of Lubricating Oils

Class Meeting No. 2
(Continued)

NOTE: Throughout the class proceedings, no attempt is made to distinguish the identity of the pupil speaking. When a series of remarks is made by pupils, it usually denotes an interchange of discussion among the class members themselves.

Leader: On this matter of waxes, we said pour point was something to be desired. In our last discussion of pour point we decided that a low pour point was desirable for a lubricating oil. We immediately remove some of these products we call waxes. Are they undersirable from the viewpoint of lubrication?

Pupil: Only in that they interfere with suction.

Leader: We will say fluidity at low temperature. This is undersirable.

(Writes on board):

Wax undersirable	*Desirable*
Fluidity at low temperature	Viscosity index
Not a good lubricant	

Pupil: That is questionable, isn't it? A better fluidity is always obtained with an oil of low pour point.

Leader: If the lubricating oil were not dewaxed in the plant, what would be the pour point on SAE 20 oil?

Pupil: About 60 or 70.

Pupil: About 120.

Leader: I think it would be about 100. Do you feel that your car is being lubricated better by the presence of wax?

Pupil: No.

Leader: All the work that has been done indicates that wax is not a good lubricant.

Pupil: I think wax helps lubricate to a certain extent as a fluid.

Pupil: Low viscosity.

Pupil: Isn't the Standard's Iso-Vis a similar idea? The diluent is not a lubricant, nevertheless it has no harmful effect on the actual lubricating value of the other material.

Leader: I suggest that everyone learn what he can about wax as a lubricant. There are several kinds of wax. What is the first one?

Pupil: Paraffin.

Leader: The text mentions four general types of petroleum waxes: that "obtained from pressing the light viscosity distillates and sweating the wax so obtained free from oil; slop wax, which is present in the high viscosity distillates and commonly considered unpressable; petrolatum, associated with cylinder stocks, and rod wax, which separates from the crude oils in the wells around the sucker rods." Rod wax is probably a combination of all types. In refining we have:

Paraffin—Wax distillate

Paraffin—Slop wax

Paraffin—Bright stock

"According to one theory the same types of hydrocarbons are present in all these waxes."

Pupil: It seems evident that paraffin is a combination of other waxes.

Pupil: There is perhaps some argument that it is different.

Leader: It may be. We have two theories. All three waxes are the same except for inhibitors. The observed physical differences between them should be ascribed to the inhibiting action of certain impurities that modify the crystal form of the separating wax. What kind of wax contains large quantities of impurities that inhibits the formation of large crystals?

Pupil: Amorphous.

Leader: And this slop wax, what about it? This wax is crystalline. The other theory is that you have two types of wax—crystalline and ceresin.

Pupil: Even heat will transform practically all the ceresin wax to crystalline wax.

Pupil: Sachanen had four articles published in 1931 in which he and two others collaborated on a discussion of ceresin and crystalline wax; they stated very definitely that there are two types of wax. It is possible to distill the ceresin wax with only a slight change. It has a low melting point as compared with the paraffin waxes, and yet there is a difference in gravity; one is high and the other low.

Leader: What is the gravity of the 126-30 M. P. crystalline wax?

Pupil: About 42, I believe.

Leader: That is correct. Who remembers the gravity of the paraffin from bright stock sources? I am under the impression they are lower.

Pupil: The author gives it as about 52. They have a high molecular weight, so that would throw them the other way.

Leader: I am under the impression they are about 35 deg. A.P.I. for they are heavier than the crystalline waxes.

Pupil: Didn't you say that in distilling ceresin waxes, you may obtain some paraffin?

Pupil: Kalichevsky says transformation is never complete. He doesn't say how far they go, but he says distillation does change paraffin to a ceresin.

Pupil: The change can be made by repeated distillation.

Pupil: Ceresin wax can be changed to the crystalline form of wax by heat.

Pupil: A wax cloud developed in lubricating oils. When the same dewaxed charging stock was distilled at reduced temperatures the oil remained bright.

Pupil: That is high melting point insoluble wax.

Leader: Are those impurities due to improper fractionation?

Pupil: They are not there when you subject them to high temperatures.

Pupil: They are present as very tiny crystals and by subjecting them to high temperatures for a period of time and then allowing the crystals to form slowly during cooling—a long period of digestion it might be called—the larger crystal growth makes them visible.

Leader: Have you ever separated those crystals?

Pupil: We tried to do that, but they came right on through.

Pupil: Suppose we compare it to water. When we have a coagulating agent we have a nucleus on which to form an insoluble particle that precipitates out of the treated solution. Paraffin wax forms large crystals. There might be some agent in the oil that is acting similar to the coagulent in

water. In ceresin wax we do not have this, and by heating this oil we might release some coagulating agent that would give a nucleus for the crystalline growth. Would that be possible?

Leader: Yes, I think it would.

Pupil: If an oil is subjected to high temperatures the wax crystalline growth will form until it is quite plain. Would you say that by subjecting the oil to high temperatures that you have destroyed the inhibitors?

Leader: No, not in a case like this.

Pupil: Then you have changed the form of the wax if you have not destroyed the inhibitor.

Pupil: Heavy treating of sulphuric acid produces poor cloud, doesn't it? According to Kalichevsky, carbon in colloidal form acts as a pour point depressant, therefore overtreating removes the carbon.

Pupil: I think we possibly had the worst trouble with wax cloud when we were centrifuging after contact rather than before. At one time we finished the oil after we had acid-treated and contacted and then centrifuged and finished on the distillation unit and at that time we had trouble with clouding.

Leader: The removal of wax raises the oil viscosity. Some benefit accrues to your yield of lubricants.

Pupil: You say that the wax removal raises the viscosity of the oil?

Leader: Yes. When the wax distillate is chilled at a rather slow rate, wax crystals form, usually adequate to judge how it will press. The size of crystals ordinarily would be classified as plates. When they are this shape, they can be depended upon to press well. Next we have the group that is shaped like needles. The ordinary miscrope requires the addition of polarized light to see them. One theory is that the needles are formed by these plates being rolled up like a sheet of paper and end up with a needle structure. The needle is important if it is interspersed with the plate-shaped crystals because then they serve to separate the plates and form a lattice-work through which the oil can drop slowly out of the cake due to sweating characteristics. The theory referred to of forming these crystals assumes that there will be enough inhibitor present to cause them to cut up. That makes a beautiful theory and indications are that such does take place.

Pupil: Wouldn't another theory be used with respect to crystallography of minerals when one specific mineral may have more than one crystalline form and the form it takes depends upon the conditions of its precipitation and rate of growth?

Leader: I am sure that is true. This same oil, if chilled slowly and then chilled rapidly causes these plates to take a different form and much smaller plates result when chilled rapidly.

Pupil: But it takes that form rather than forming the plates and rolling the plates up. You have a distribution formation with a difference in orientation of axis and it will have a different reaction to polarized light. I am wondering whether in the case of needle-like crystals you haven't an entirely different crystal form. That is the case with some minerals when there are two different crystal forms of the same mineral, the forms varying with the condition of deposition and cooling.

Pupil: Isn't the forming of crystalline structure due to fractionation?

Leader: The amount of inhibitors present? Yes.

Pupil: We used to get into pressing troubles and would suspect trouble in the vacuum unit.

Pupil: Anything that might affect the growth of crystals—any outside conditions such as pressure or temperature—might cause the form to change from one to the other, but each form would be an inherent condition of that growth itself.

Pupil: Referring again to the article by Sachanen, the pictures of the ceresin wax proved it was definitely a needle-type wax, and when added to the plate-type paraffin waxes the plates disappeared, but there was a small amount that was found to be still holding the oil. There was no way to get the oil out because ceresin retains it.

Pupil: Ceresin doesn't release the oil like the other wax?

Pupil: When mixed together, there was a very definite change.

Leader: In case needle wax is not present, then these two tend to join and mix with the oil.

Pupil: It works in the presses that way also and gets sticky.

Pupil: Didn't you say that the needle formation of crystals on the presses tends to impede pressing of wax and that the points of the needles will enter into the wax itself and fill up the openings of the filter blankets?

Leader: The observations were that the needles would not hurt the pressing, even though that might be a possibility, but we have never carried it to the extreme; however, we did find that sometimes you can press all right and not sweat satisfactorily.

Pupil: Do you mean that if there were no needles present you would add some quantity of amorphous wax so that it would sweat?

Leader: We are not ready to discuss that yet.

Pupil: Ceresin would not provide needle crystals, would it?

Pupil: Yes, Sachanen says it would.

Leader: The third formation was the mal-crystals. As a rule they are not satisfactory for pressing or sweating. To show what happens sometimes in regard to the size of these crystals, the laboratory noticed that the wax distillate being made from crude oil had a different bloom to it. The bloom used to be blue, but this one was green. We then tried blending 1 percent crude oil with 99 percent wax distillate from the run tanks to see the result. It had that same green bloom. It was found that a heat exchanger in which crude oil was interchanged with wax distillate was leaking a small amount of crude oil. This resulted in the wax distillate having a green bloom. So we tried a number of different percentages of blends and found that 1/7 of 1 percent of crude oil by volume in the wax distillate reduced the crystals to ⅓ the size they are here. That would indicate that the inhibitor effect of the crude oil was very marked. There is a very interesting formula on page 35 of our text, expressing the growth of wax crystals. The formula is reproduced here:

$$v = \frac{L}{u}(c - s)$$

where:

v = the velocity of growth

L = a constant depending upon the concentration of impurity, rate of cooling, and method of stirring

u = the absolute viscosity of the medium

c = concentration of paraffin

s = solubility.

If the chillers are so timed that the oil is chilled too fast, I feel quite certain that you will get wax crystals of much poorer shape than if the timing were such that it went through slower. We proved that to our satisfaction by taking semi-solidified wax distillates and examining them in a cold room. Let us assume an absolute viscosity based on 100 viscosity at 100 neutral. If naphtha is added and the viscosity thus reduced by half the velocity of the crystalline growth is doubled. So lowering the viscosity is quite a valuable factor in determining the growth of crystal formation. By lowering the viscosity, you improve chilling and that is again a matter of surface of your crystals.

EDITOR'S NOTE: This series on the manufacture of lubricating oils will be continued in an early issue of *The Petroleum Engineer.*

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War Material Conservation in Pipe-Line Communication Systems

PETROLEUM ENGINEER Exclusive Feature

☆ A few suggestions on planning "around" scarce materials

by L. E. Adler

Communication Engineer, Magnolia Pipe Line Company

Foreword

Even the printed page must be conserved during these perilous times. Accordingly, the writer has confined his message to a few typical examples of planning "around" scarce materials on the theory that "A word to the wise is sufficient."

New Projects

Avoiding new outside plant construction. Open-wire telephone circuits, even when copper is readily available, usually cost $125 to $200 per circuit mile when strung on existing pin-space. When new pole-lines are required, the cost becomes $350 to $650 per circuit mile, assuming only one or two circuits are involved, as is usually the case.

Even more important to the war effort is the amount of key material involved, for example, to string one additional No. 8 copper circuit (2-wire) 100 miles on existing pole-lines on additional cross-arm requires 42,000 lb. copper, 37,000 lb. steel (braces, bolts, brackets, etc.), 7,000 glass insulators, and 3,500 creosoted wood or steel cross-arms.

On the other hand, one or more additional "carrier" voice-channels can be superimposed on any existing circuit at 4 to 8 percent of the cost of stringing a new circuit. Moreover, this vital fact predominates: Only a fraction of 1 percent of the above vital material is required to manufacture the equipment, which eliminates the need for building a new line.

As the additional carrier channels do not affect the primary telephone and telegraph service already handled by the existing circuits, it follows that before proceeding with any project that involves the use of large amounts of vital material, every pipe-line communication engineer should investigate all alternative possibilities by analyzing all available routes by means of which carrier service may be established.

L. E. ADLER

outside regular office hours is mayor of Fruitdale, Texas, a suburb of Dallas—Otherwise he is communication engineer for the Magnolia Pipe Line Company, and also acts in the capacity of consulting communication engineer for pipe-line, railroad, and power companies relative to their private communication systems—Before joining the Magnolia staff he was for 18 years central office equipment engineer with the Southwestern Bell Telephone Company—Is a member of the American Institute of Electrical Engineers.

Using less expensive construction. When short extensions of existing field lines are required, inexpensive iron wire should be considered in place of copper. Although this is undesirable from the general transmission standpoint, there are many cases in which such procedure will make no practical difference.

Raiding the "junk-pile."

(a) Every pipe-line communication shop or warehouse is cluttered up with removed equipment such as old magneto wall sets, desk-stands, small switchboards, etc. Much of this is repairable and although it may not be modern in design, it is good enough to place at unimportant points, thus releasing better equipment for use elsewhere.

(b) Short pieces of switchboard cable can be stripped to provide a supply of color-coded switchboard wire for local farms, etc.

The ingenuity of the reader can work out many other examples of possible conservation and reclamation.

Reduction of maintenance expense and materal.

(a) On local-battery telephones most companies employ three No. 6 dry cells for transmitter battery. Try using only two for awhile. You will be surprised in many cases with the very small difference in transmission output as compared with the large saving in batteries.

(b) Linemen who clear trouble in company-owned passenger automobiles must go "Scotch" on tires. Much rubber can be conserved by stopping the common practice of letting the division lineman drive these company cars to and from their homes. This should be practicable wherever public transportation is available for home travel.

(c) Where ordinary dry cells are used to provide operator's transmitter battery for small magneto switchboards, the average life is from 5 to 10 weeks. By using "air-cell" batteries of the Le-Carbone or Ever-Ready type, the life is extended to about two years. This not only reduces battery power costs, but in many cases eliminates several expensive trips per year to replace the short-life dry batteries.

(d) The expense of maintaining local-sounder batteries in isolated telegraph stations can be eliminated in some cases by going back to the old "main line" type of sounder, which does away with both relay and battery or rectifier.

These are only a few items. Any lineman, installer, engineer, or official familiar with his job can look around and find conservation possibilities not discussed by the writer.

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Intangible Drilling and Development Costs

The Bureau of Internal Revenue formally released June 2, as G.C.M. 23243, the text of the recent ruling revoking G.C.M. 23034 and restoring the former established practice with respect to intangible drilling and development costs, thus indicating acceptance of the Fifth Circuit's Ambrose and Retsal decisions, reported in our Mimeograph 4523, April 23, 1942. The official text of G.C.M. 23243 follows:

"In G.C.M. 23034 (I.R.B. 1942-1, 6), which was based upon the decision of the Board of Tax Appeals in W. D. Ambrose et al v. Commissioner (42 B.T.A. 1405) and Retsal Drilling Co. v. Commissioner (42 B.T.A. 1057), it was held that the option granted by Section 19, 23 (M)—16 (A) (1) of regulations 103 to charge to expense intangible drilling and development costs incurred by oil and gas operators includes amounts paid to an independent contractor for the drilling of a well under a 'footage' contract, unless such contract is a 'turnkey' contract and that payments to a contractor under a contract that is neither a turnkey nor footage contract are capital expenditures if the contractor is an independent contractor but may be charged to expense under the option if the contractor is an employee or agent of the operator rather than an independent contractor.

"The Circuit Court of Appeals for the Fifth Circuit in the recent cases of Commissioner v. W. D. Ambrose et al (decided April 8, 1942), Retsal Drilling Company v. Commissioner (decided April 17, 1942) and E. C. Laster et al v. Commissioner (decided April 17, 1942) held, contrary to the conclusion expressed in G.C.M. 23034, supra, that payments representing intangible drilling and development costs made by operators of oil and gas properties under contracts which were not true 'turnkey' contracts were within the option provided in Article 23 (M)—16 of regulations 86 and thus deductible as business expenses, irrespective of the legal relationship between the taxpayer and the drilling company, i. e., whether the taxpayer is an independent contractor or an employee.

"Inasmuch as the results of the cited court decisions are in accord with the general recognized Bureau practice prevailing prior to the cited board decisions, G.C.M. 23034, supra, is hereby revoked.

M. B. Leming,
Acting Chief Counsel,
Bureau of Internal Revenue."

OPC Plan for Gulf Refiners

Approval of a plan that will assure full-scale production of petroleum war products in the Gulf Coast area, and at the same time afford assistance to refiners of ordinary products, especially small operators, was announced June 11 by the OPC.

The announcement states:

"The plan was developed by the petroleum industry general committee for the Gulf Coast district (under authority of OPC Recommendation No. 33) to counteract interference with Gulf Coast refining activities attributed to transportation dislocation.

"Approved by Deputy Co-ordinator Ralph K. Davies, it specifically assures to all refiners in the area the right of proportionate participation in the output and disposal of ordinary petroleum products, whether or not they are also producing special war products.

"The plan will apply at first only to seaboard refineries in what the Bureau of Mines designates as the Texas-Louisiana Gulf Coast area, and is based upon the transportation, output, and demand available to that region. Later, if necessary or advisable, it may be made applicable to interior refineries in the Gulf district.

"The plan will operate as follows:

"The District Refining Committee of the industry will determine for each calendar month, on the basis of OPC reports and forecasts, the total outlet available for refined products from the district. On or before the first of each month, the OPC director of refining will estimate and report to the committee the rates at which production of petroleum war products is necessary in the district. Using this information, the committee then will devise a plan for each calendar month for operation of refineries in a manner that will:

"(a) Produce petroleum war products with minimum refinery runs of crude petroleum.

"(b) Distribute equitably among all refineries the remainder of the total refinery outlet available in such a manner as to give them approximately the same percentage of operations. In determining this percentage, the base used is to be the average crude oil runs for the last six months of 1941.

"The final schedule of crude runs set by the refining committee will be reported by it to the Gulf Coast district transportation committee, which will arrange schedules for the shipment of products.

"If transportation is not available for the full movement of the products provided for by the crude run schedule, facilities will be provided, first, for the petroleum war products, and second, for other products or refineries producing war products to the extent necessary to enable them to continue producing war products. The transportation then remaining will be distributed equitably among all refineries on the same basis that crude runs are distributed and with the same provision for the sharing of any deficiency.

"Crude run schedules formulated by the refining committee for any calendar month are to be submitted by it to the Chief Counsel, Office of Petroleum Co-ordinator, on or before the 25th day of the month preceding. They will not become effective until approved by him and ordered into operation by the Co-ordinator or the Deputy Co-ordinator.

Survey of Industry's Ability to Produce Synthetic Rubber

A comprehensive nationwide survey to investigate the oil industry's ability to produce raw materials for synthetic rubber by utilizing present refining equipment without impairing the production of other war products, was announced June 15 by the OPC.

The OPC statement follows:

"The investigation, called for in a formal directive (No. 52 of the Co-ordinator) will be conducted by the Petroleum Industry War Council and other industry committees, Deputy Co-ordinator Ralph K. Davies said.

" 'Since the severence of this Nation from the major portion of its source of supply of natural rubber, the need for instituting and expanding programs for the production of raw materials to be made into synthetic rubber has become increasingly pressing,' Davies said.

" 'It appears likely that the petroleum refining industry can contribute to this need in a substantial way by the application of various processes to existing operations, the use of available charging materials, and the maximum utilization of existing equipment, without impairment of the production program for other war products.

" 'While there is every reason to believe that the petroleum industry can make a substantial contribution at an early date to the production of raw materials for synthetic rubber, it must be emphasized that no false hopes should be created that this material will be available for civilian consumption, but that it will be used for military requirements. Indirectly, however, satisfying military requirements will greatly expedite the date when civilian consumption will become available.'

"Davies made clear that the Office of Petroleum Co-ordinator and the oil industry are doing what they can to contribute as much raw material as possible for the refining of synthetic rubber at the earliest possible date. The utilization of existing equipment will greatly aid in both the time and saving of critical construction materials.

" 'The industry will do all it can to produce raw materials for synthetic rubber,' Davies declared. 'How the rubber is distributed will be decided by the appropriate agencies.'

"OPC's Refining Division has been exploring the problem with technicians of the industry during the past few weeks and has already received several encouraging reports. Technical details and all information gathered will flow to the refining centers for use by both large and small refiners wherever application can be made.

"The directive calls for reports that will show the progress being made in the survey. Whenever the investigation has progressed sufficiently, plans for the production of raw materials for synthetic rubber may be submitted to the Director of Refining for the approval of the OPC.

"When a production plan is found acceptable by the Office of Petroleum Co-ordinator, the member or members of the petroleum refining industry submitting it shall carry on negotiations with OPC regarding agreements for the production and sale of the raw materials."

Exceptions for Gas Wells in Missouri, Oklahoma, Kansas

Increased demands by war industries for natural gas from the shallow areas of Missouri, Oklahoma, and Kansas will be met by drilling additional wells in these States, the office of Petroleum Co-ordinator Harold L. Ickes stated June 20.

The OPC announcement states:

"Armament factories, aircraft plants, and other industries producing important war products make it imperative that the required quantities of natural gas be available, Deputy Co-ordinator Ralph K. Davies explained.

"Permission to drill the wells on drilling units less than 640 acres was recommended by the Office of Petroleum Co-ordinator for War and issued by the War Production Board as Supplementary Order No. 2 to Conservation Order M-68.

"The supplementary order applies to the entire State of Missouri, 43 counties in Kansas, and 17 counties in Oklahoma.

"In Kansas, the order applies to that portion of the state that lies east of Range Two and east of the Sixth Principal Meridian. This includes the eastern half of Washington, Clay, Dickinson, and Marion counties, and all of Cowley, Butler, Chase, Morris, Geary, Riley, Marshall, Pottawatomie, Wabaumsee, Lyon, Greenwood, Elk, Chautauqua, Montgomery, Wilson, Woodson, Coffey, Osage, Shawnee, Jackson, Namaha, Brown, Doniphan, Atchison, Jefferson, Leavenworth, Douglas, Franklin, Anderson, Allen, Neosho, Labette, Cherokee, Crawford, Bourbon, Linn, Miami, Johnson, and Wyandotte counties.

"In Oklahoma, the order applies to Osage, Washington, Nowata, Craig, Ottawa, Pawnee, Tulsa, Rogers, Mayes, Delaware, Creek, Okmulgee, Wagoner, Cherokee, Adair, Muskogee, and Sequoyah counties.

"Under the order as it originally was issued, materials could not be used for natural gas wells unless they were drilled on units of not less than 640 acres. Because this regulation did not permit producers in the three states to meet increased domestic and industrial demands, the supplementary order now allows drilling on units of not less than 40 acres.

"In 1941, the area produced and sold in and within the immediate environs 23.1 billion cu. ft. of natural gas, of which 14.9 billion cu. ft. (64.5 percent) were used by industries or electric-power producers and 8.2 billion cu. ft. (35.5 percent) by domestic and commercial consumers."

M-68 and M-68-c Do Not Apply in Canada

Two orders providing for conservation of materials in the production and marketing of petroleum and petroleum products were amended June 25 by the Diretcor of Industry Operations to restrict their application to the United States, its territories and possession.

This action was taken to make it clear that the restrictions continued in orders M-68 and M-68-c do not apply to Canadian oil companies to which priorities assistance has been extended by a recent amendment to Preference Rating Order P-98. Application of the ratings by Canadian companies will be subject to Canadian government restrictions.

P-98 Extended to Canadian Petroleum Industry

Canadian petroleum operators have been placed on substantially the same footing as United States operators as far as priority assistance is concerned, the Director of Industry Operations announced June 19. Action was taken through Amendment No. 1 to Preference Rating Order P-98, extending the provisions of P-98 to the Canadians.

New Removable-Type Circulating Valve

PETROLEUM ENGINEER Exclusive Feature

☆ **Used to bring in Ville Platte wells—Simply pumping into tubing opens horizontal ports in special tubing nipple above packer—Valve automatically closes ports when pumps are shut down**

by John O. Farmer
Engineer, Otis Pressure Control, Inc.

PURELY and simply a "war born baby", the new removable-type circulating valve described in this article probably would not have been developed for some time had it not been for the complete conviction and dogged determination of a veteran pressure control expert and a very proficient production engineer.* By combining the knowledge of the expert, the experience of the engineer, and the resourcefulness of both men, the new tool was conceived. This was merely the beginning, however. As war contracts with A-1-A ratings definitely had the right-of-way, the task of creating interest in a new oil-field tool was difficult and very discouraging. Had it not been for the repeated insistence of these men and their confidence in the need for, and the practicability of, such a tool, it—like many other things—probably would have been "shelved" at least for the duration.

Need and Purpose of New Tool

The purpose of this new tool is to provide a means to open circulation ports above a packer by pumping into the tubing, to close these ports when the pumps are shut down, positively to prevent interzone communication at all times, and to alleviate the task of moving the tubing or pulling the side-door choke to produce the same result.

The need for such a tool became increasingly urgent with the drilling of deeper and higher pressure two-zone wells. The task of bringing-in these wells was at first most awkward and dangerous primarily because it involved swabbing or circulating-in the annular space before the packer had been set and the tubing connections permanently installed. When this method was used, it was necessary to set the packer, land the tubing, and tie-down the surface connections after swabbing or circulating had started the well to unload. In most instances, it was a race against time to install the surface connections before the well would become completely unloaded and thus bring the high pressures to the surface. The removable side-door choke has been generally adopted to alleviate this undesirable operation and has greatly facilitated the entire completion procedure.

*I. A. Miller with Otis Pressure Control, Inc., and Jim Clark, The Continental Oil Company.

JOHN O. FARMER

graduated from the Missouri School of Mines, Rolla, Missouri, in 1933 with a B.S. degree in petroleum engineering—This year (1942) he received an M.E. degree from the same school—After graduation in 1933 he joined the staff of The Carter Oil Company as a junior engineer and spent the succeeding two years in the Oklahoma City, Seminole, and Fitts fields of Oklahoma—In 1935 he became associated with Otis Pressure Control, Inc., Dallas, Texas, in an engineering capacity.

The side-door choke provides a means of swabbing or circulating-in the tubing and casing annulus simultaneously after the packer has been set and the surface connections permanently installed. Generally, the practice has been to blank-off the ports by installing the side-door choke after the two zones had completely cleaned themselves. During the few hours required for this operation, the two zones were open to each other. In a few instances this was undesirable due to a high-pressure zone charging a lower pressure zone. Originally it was for the purpose of preventing this interzone communication that the circulating valve was constructed.

Operation and Description of Circulating Valve

Removable yet positive and fully automatic in its operation, the new valve permits circulation above a packer by pumping into the tubing. Closing of the circulating ports the instant pumping is stopped, prevents any chance of interzone communication in two-zone wells.

The circulating valve is simply a side-door choke modified and extended to include a spring-loaded cup section, a perforated upper cup mandrel, a blank lower cup mandrel, and a back-pressure valve built within this lower cup mandrel. When in its regularly seated position, the blank cup mandrel is adjacent to the ports in the landing nipple, preventing flow through these openings. The blank cup section is held in this position against upward thrust by the locking device and against downward thrust by the resistance of the coiled spring to compression. Consequently, the valve can be moved downwardly when sufficient pressure differential is created across the valve to compress the coiled spring. This action forces the blank cup mandrel downward and moves the perforated cup mandrel into the position adjacent to the ports in the landing nipple, thereby permitting circulation. Although not affecting flow in an upward direction, the back-pressure valve prevents downward flow and causes the pump pressure to create instantly a differential across the valve causing it to open. The back-pressure valve also prevents exposing the lower formation to the pump pressure. The instant the pressure differential across the valve is released the coil spring returns the blank cup mandrel to its original position thereby closing the circulating ports.

Both cup mandrels carry opposing seating cups mounted on each end to prevent flow in either direction around the cup mandrel. The pressure seal seating cups and the locking device are identical to those used on the conventional side-door choke.

Circulating Valve Easily Removed

Perhaps the most practicable feature of this tool is that it can be pulled and rerun under pressure on an ordinary steel measuring line. Excessive bottom-hole temperatures and pressures such as those encountered at Ville Platte are most abusive to the packing elements of

subsurface tools. The fact that the valve can be easily pulled to replace the cups and rerun without moving the tubing or breaking the packer seal makes an otherwise impracticable tool most applicable and desirable for all flowing two-zone completions.

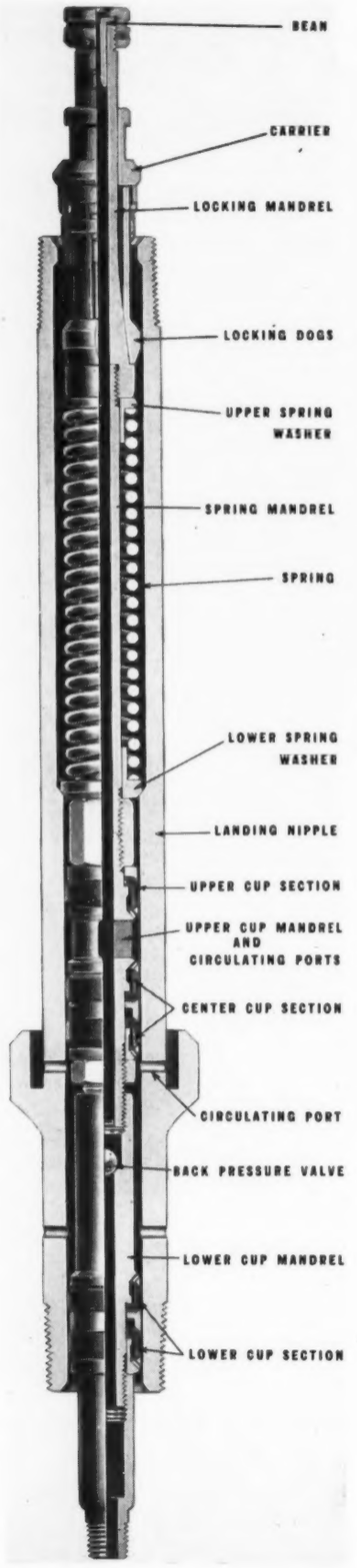

Fig. 1. New removable circulating valve

The procedure for running and pulling the circulating valve is exactly the same as that used for the conventional side-door choke.

Use at Ville Platte

Production at Ville Platte is from the Sparta, Tate, and Haas sands from 8887 to 9089 ft. and the Wilcox sands from 10,055 to 10,157 ft. Bottom-hole pressures approximate 4000 lb. per sq. in. and bottom-hole temperatures are usually in excess of 200°F. The circulating valve is used here to facilitate bringing-in the wells and, in some instances, to provide a means to "kick-off" the tubing or casing annulus later should either become loaded. The usual practice is to "make-up" the circulating valve on top of the second or third joint of tubing above the packer. After the tubing string has been landed and all Christmas tree connections permanently installed, water is pumped into the tubing and circulation begun above the packer. When the water has displaced the mud, high-pressure gas is connected into the tubing to displace part of the head of water so that the formations will kick-off. As soon as the formations have cleaned themselves the well is ready for its production tests.

Summary

Although this tool is quite new, results from its use have been most satisfactory and encouraging. All installations have been made at approximately 10,000 ft. and under the most adverse conditions of temperature, pressure, and mud. The advantages realized from the new tool may be summarized as follows:

1. Under no condition are the two zones of a dual completion produced simultaneously.
2. Accumulated head in either or both tubing and casing may be unloaded simply by connecting high-pressure gas into the tubing.
3. The need of pulling the side-door choke to permit circulating is eliminated.
4. Both zones may be circulated-in after the packer has been set and tubing connections permanently installed.
5. Provides simple but positive means to circulate mud from above a packer in a single-zone well.

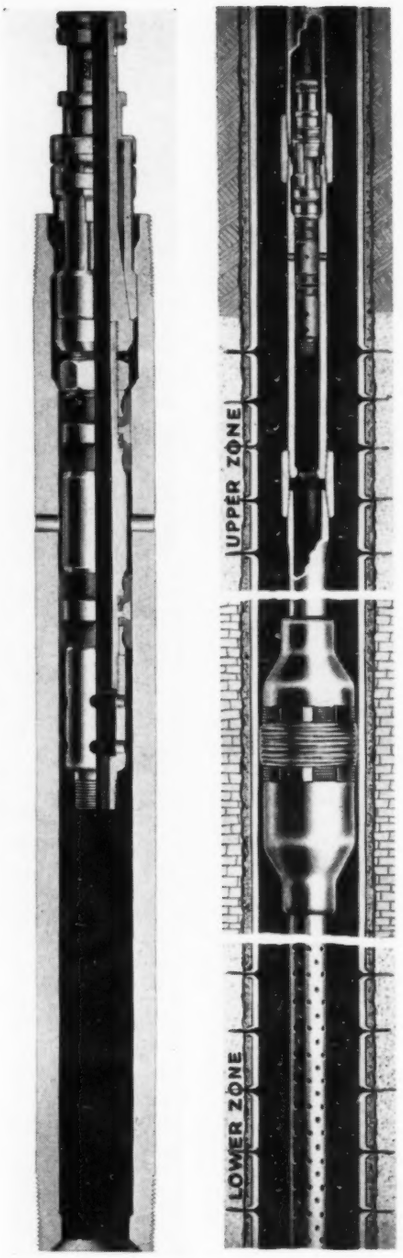

Fig. 2. Regular bottom-hole side-door choke (left) and its relative position in well when installed (right)

Fortunately the side-door choke locking device and cup sections, which are used on the circulating valve, had already been proved practicable, for there are more than 650 side-door choke installations. This greatly simplified the initial design and construction work and permitted the preliminary work to be accomplished with minimum effort.

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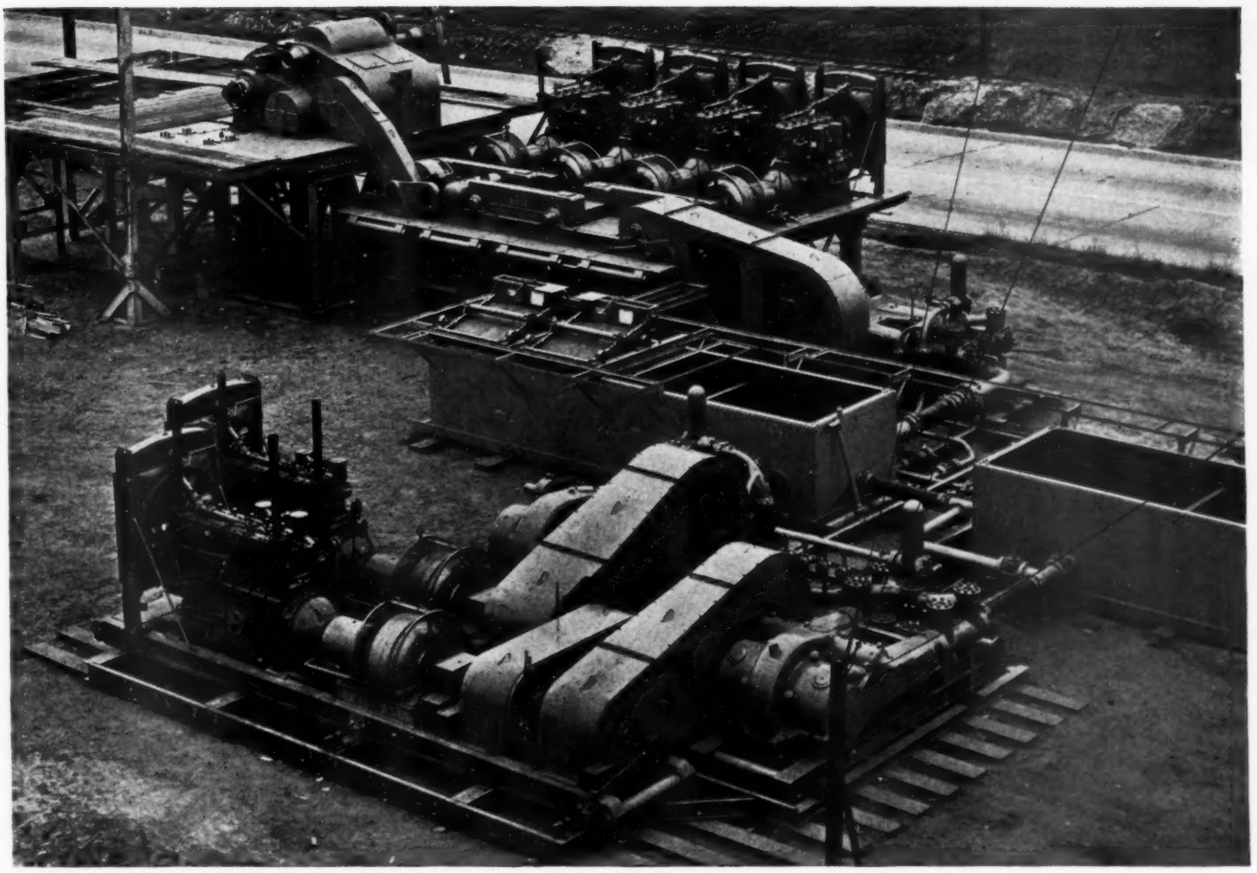

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P 762.1

"Simple" Steam Flow Chart

by W. F. Schaphorst

FOR a number of years this writer has been trying to produce a steam flow chart of utmost simplicity, and believes the accompanying chart is the answer.

Thus, for example, what size steam pipe shall be used when the steam pressure is 200 lb. gauge and 225 lb. of steam is to be used per min.?

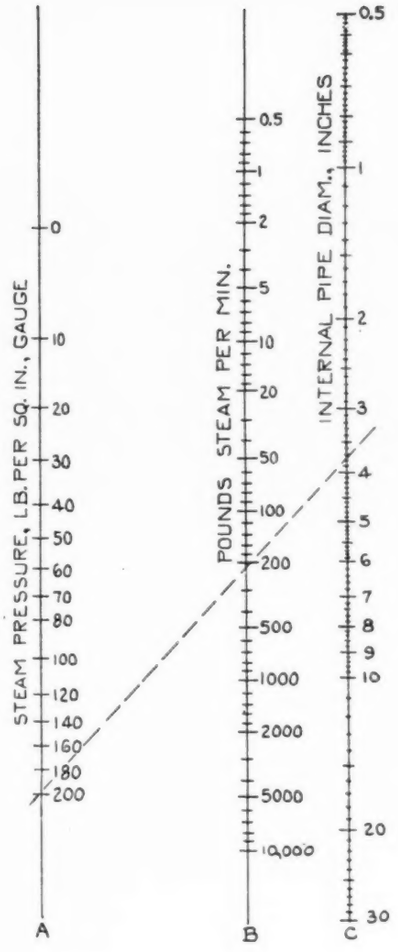
The dotted line drawn across the chart shows how easily the pipe size is determined. Simply run a straight line through the 200, column A, and the 225, column B. The intersection in column C gives the answer as 3.75 in. I.D. This is very close to a 4-in. pipe; therefore, a 4-in. pipe should be used.

The chart is based on the velocity of steam that is used most, which is 6000 ft. per min. Therefore, if you want to use a different velocity than 6000 it is not difficult to make the necessary correction. Thus, if the velocity were 12,000 ft. per min. in the above problem, it is obvious that the area of the pipe in cross-section would be exactly one-half of the 3.75-in. pipe as determined by this chart, and, as the area of a circle 3.75 in. in diameter is 11 sq. in., the area of the pipe we want will be 5.5 sq. in. The diameter, we then find, will be 2.65 in. That is not far from a 2½-in. pipe, which probably can be used, but if there is any question it is generally better to be safe and use the next larger size, which would be 3 in. in diameter.

Again, if the steam pressure is known, column A, and the pipe is already installed, the diameter of course is a known quantity, column C, and the pounds of steam that the pipe will carry per minute is easily determined by simply connecting the known factor in column A with the known factor in column C. The intersection with column B then gives the pounds of steam per minute—at 6000 ft. velocity, of course. For other velocities size allowance is readily made, as above.

The chart will be found satisfactory for most short pipes where the pressure drop is small, amounting to only 2 or 3 lb. Most steam pipes are short and it is unnecessary to worry about the complexities to be found in most of the steam flow formulas commonly seen in print. Besides, even when the complex formulas are used, this chart will serve as an excellent check in showing the steam flow under ideal conditions, with friction neglected.

☆ ☆ ☆



P 771.2

U. S. Bureau of Mines Makes Study of Condensate-Type Wells

SEEKING more effective methods of developing extremely deep condensate-type oil wells, especially in the Gulf Coast area of Louisiana and Texas, the U. S. Bureau of Mines has studied experimental data obtained from one well in which gas and liquid constituents of reservoir fluids were subjected to a wide range of tests.

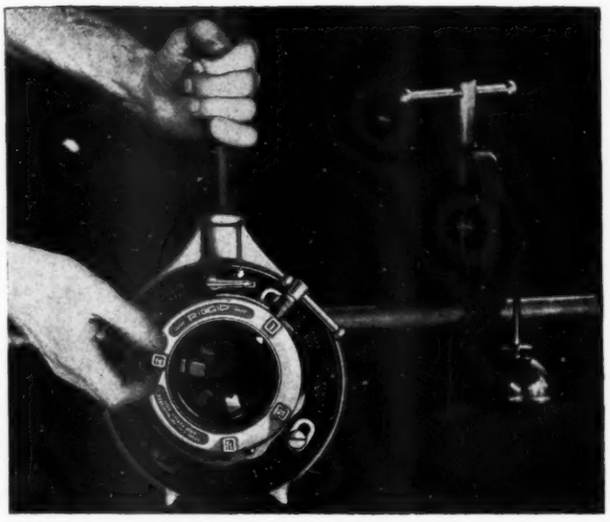
Data were obtained for the complete range of pressure, temperature, and mixture proportions in efforts to provide a reference scale for evaluating properties of fluids produced from similar wells at different gas-liquid ratios. The gas and liquids obtained from one well were recombined in different proportions to provide ten natural hydrocarbon mixtures for study at pressures up to 5000 lb. per sq. in. and at temperatures ranging from 70 to 280°F.

Proper control of underground pressure during production is essential to economical development of condensate-type oil wells, the Petroleum and Natural Gas Division of the Bureau reports. Unwise reduction may result in the precipitation as liquid and subsequent loss of valuable hydrocarbon components of gas being removed from the well.

Knowledge of condensation processes is becoming increasingly important as this type of operation is extended to recover gas and liquids from newly-developed reservoirs that usually are 10,000 ft. or more below the surface.

The research was conducted under a coöperative agreement between the American Gas Association and the Bureau of Mines. Tests were conducted at the Bureau's Petroleum Experiment Station, Bartlesville, Oklahoma, by Kenneth Eilerts, physical chemist, and R. Vincent Smith, assistant chemical engineer.

A copy of the report, Report of Investigations 3642, "Specific Volumes and Phase-Boundary Properties of Separator Gas and Liquid Hydrocarbon Mixtures," may be obtained by writing the U. S. Bureau of Mines, Washington, D. C.



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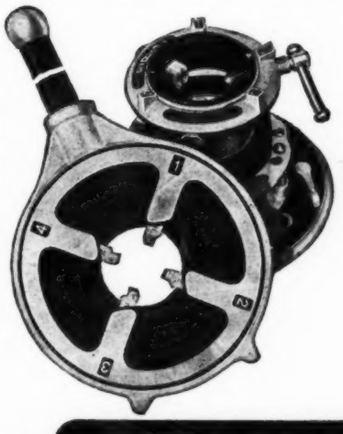

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Increasing Recovery of Liquefied Petroleum Gases in Natural Gasoline Plants*

☆ Ways and means of increasing extraction with existing equipment

by J. W. Wilson
Production Engineer
Gasoline Division, Cities Service Oil Company

TOTAL sales of liquefied petroleum gases, as such, have increased on an annual basis from 221,641 gal. in 1922 to 313,456,000 gal. in 1940, and an estimated total of 445,000,000 gal. during the year 1941.[1]

The increasing number of uses to which the individual hydrocarbons in the liquefied petroleum gas range are being put, as well as the favorable reception of these gases as domestic and industrial fuels, is causing an accelerated demand that was especially noticeable in 1940 and 1941.

Since December 7, 1941, liquefied petroleum gases, particularly the butanes, have assumed a new and greater importance. Prior to the inception of the war program, only a small part of the natural gasoline industry's products had been used in the manufacture of 100-octane aviation gasoline, and even less in the manufacture of synthetic rubber.[2]

The present program has been variously estimated at 200,000 bbl. per day or more of 100-octane aviation gasoline.[3] In order to present some idea of the enormous volumes of liquefied petroleum gases that will be required to produce this volume of aviation gasoline, the following figures based on the alkylation process are illustrative:

It has been reported that the alkylate required in the blend may vary from 15 to 60 percent of the total, depending upon the characteristics of the other blending materials used. Assuming 45 percent as an average figure, then for 200,000 bbl. of 100-octane gasoline approximately 90,000 bbl. of aviation alkylate will be required.[4] It is reasonable to expect a yield of approximately 80 percent based on a charging stock of butylene and *iso*butane in a ratio of 1:1.2. On these assumptions it would require about 52,000 bbl. of butylene and about 62,000 bbl. of *iso*butane to make 90,000 bbl. of aviation alkylate.[4] Part of the *iso*butane will be recovered from refinery tanks vapors, part from stabilization of the primary cut from crude oil, part from the natural gasoline industry, and the remainder from isomerization of normal butane. Furthermore, in order to obtain sufficient butylene, it will be necessary to convert some portion of normal butane by means of the catalytic and thermal processes.[5]

*Presented before Annual Convention, Natural Gasoline Association of America, May 14 and 15, Tulsa, Oklahoma.

J. W. WILSON

production engineer at Bartlesville for Cities Service Oil Company, was born at Abbeville, South Carolina, January 27, 1901—After attending Abbeville grade and high schools, he entered Clemson College at Ft. Hill, South Carolina, and in 1922 graduated from there with a B.S. degree in mechanical engineering—After graduating, he was employed by a predecessor company to Cities Service Oil Company as junior engineer and took training in the Doherty Training School at Bartlesville—Completing this training, he worked as plant chemist, plant superintendent, district superintendent for Kansas, and district superintendent for Oklahoma—In 1937, he was transferred to Bartlesville as production engineer in the gasoline division.

From published reports during the week of April 9, 1942,[6] it was noted that 14 oil-refining companies, representing 53.81 percent of the Nation's total crude oil refining capacity, seven chemical concerns, and four rubber manufacturers have accepted contracts with the Federal Government to build and operate facilities for production of 700,000 tons of synthetic rubber annually.

For the manufacture of 700,000 tons of synthetic rubber per year, enormous quantities of butane will undoubtedly be required. In the case of Buna-S rubber, if we assume a 45 percent by weight conversion of butane to rubber, then it would probably be necessary to produce as much as 700,000,000 gal. of butane per year for this purpose alone.[7, 8] Of this total, approximately one-half, under some estimates, will be obtained from refinery gases, and the rest from natural gasoline, cycling and repressuring plants.

In order to obtain adequate supplies of the liquefied petroleum gases for the many purposes to which these gases are put, but particularly for the manufacture of aviation gasoline, Recommendation No. 25, Part No. 1512, was issued to the natural gas and natural gasoline industries by the Office of the Petroleum Coördinator for National Defense under date of January 26, 1942. Paragraph 1512.3 of Recommendation No. 25 is quoted to-wit:[9]

> *"Extraction and Production of Existing Plants to be Increased.*
>
> "All persons, natural or artificial, presently owning or operating any natural gasoline extraction plant, cycling plant, pressure maintenance plant, or repressuring plant shall increase the percentage of butane and *iso*butane extracted from the gas processed at such plant, or plants, to the maximum quantity economically possible, and shall increase the production of butane and *iso*butane in liquid form at such plant, or plants, to the maximum quantity economically possible."

Since January 26, 1942, the synthetic rubber program has reached a stage of equal or greater importance than the 100-octane aviation gasoline program, and more recently, indications are that the rubber program may be extended to 1,000,000 tons annually

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and possibly more. Therefore, it is impossible to stress too strongly the magnitude of the problem facing the natural gasoline industry in preparing itself for maximum participation in the war effort. This paper will be limited to suggestions of ways and means of increasing the extraction of liquefied petroleum gases with existing equipment only. No attempt will be made to present any fundamentally new ideas. Instead, certain practical methods, previously presented, or in use, by others will be reviewed briefly, and references given for further reading by those who care to do so.

Fundamental Analyses and Plant Balance

Unless sufficient recent data are on hand to determine accurately the present extraction efficiency of the plant, it is recommended that sufficient fundamental, or low-temperature distillation, analyses be made to obtain a plant balance. In any event, such analyses should be made on the inlet and outlet gases, and on any vapors being lost from the plant. Samples should be as nearly representative as possible of average normal operating conditions. If the composition of the input gas is continuously changing due to well operations or other causes, it would be advisable to obtain composite samples over a period of several hours, or even over a full 24-hour period.

From the analyses of the inlet and outlet gases, the absorber efficiency for such components under existing conditions can be calculated[10], and a decision made on what changes or additions are necessary or justified to increase the extraction of the low boiling components; viz., butane and *iso*butane.

Theoretical Considerations

Cox and Arnold,[10] in a paper read before the C.N.G.A. in July, 1929, presented the following formula for the oil and gas ratio required to absorb all the normal butane that any particular type of absorber is capable of recovering under average conditions.

Oil ratio = vapor pressure of normal butane at the temperature of the oil leaving the absorber multiplied by 75, and this result divided by the absolute working pressure of the absorber, using the same units of pressure.

Stated numerically this formula is:

$$R_o = \frac{75 \times nP_4}{P}$$

This formula illustrates the fact that with increased pressure, less oil is required. It also illustrates that with reduction in absorber bottom temperature, less oil is required.

On the other hand, it is obvious that if oil rates are held constant, then with increased absorber pressure, and/or reduced absorber bottom temperature, extraction efficiencies will be increased.

In May, 1930, Alois Kremser presented his "Theoretical Analysis of the Absorption Process" before the N.G.A.A.[11] In this analysis, Kremser derived certain absorption factors that are of great practical value in the design and operation of absorption equipment. Certain definite conclusions may be drawn from this work:

(1) For economical operation, and maximum extraction efficiencies, an absorber should have a minimum of 12 theoretical plates.

(2) A 16-plate absorber of moderate plate efficiency will in general give better performance than an absorber of more elaborate design, but having a lesser number of plates.

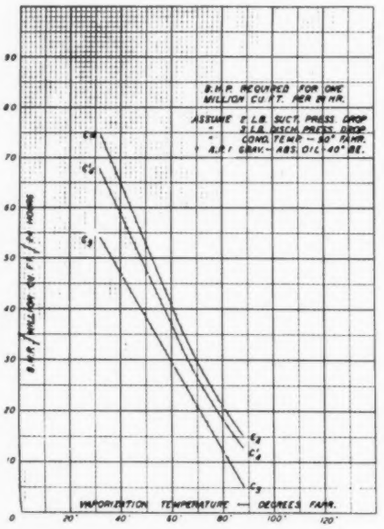

Fig. 1

(3) Absorption factor is directly proportional to absorber pressure and oil rate, and inversely proportional to the molecular weight of the absorption oil, and to the vapor pressure of the individual component to be extracted taken at the temperature of the oil leaving the absorber.

(4) For 99 percent extraction of normal butane with an absorber having 12 theoretical plates, a normal butane absorption factor of about 1.3 will be required. The *iso*butane absorption factor in that case would be about 0.85, which means that only about 85 percent of the available *iso*butane would be absorbed from the gas. For complete extraction of *iso*butane, the normal butane absorption factor will have to be increased to slightly less than 2.0.

If the number of theoretical plates were increased to 16, the absorption factor required for any single component would be reduced to 1.2, and for an infinite number of plates, this factor would be about 0.99. As it is doubtful whether any absorber now in operation has a plate efficiency of 100 percent, it will probably be more economical for maximum extraction of the liquefied petroleum gases to use more than 16 actual plates, in order to keep oil rate requirements as low as possible. Unless plate efficiencies are unusually low, 24 actual plates should give excellent results.

(5) From statement (3) above, it is obviously an advantage to use a high-gravity, low-molecular-weight absorption oil when possible. Kremser found that the absorption efficiency of the oils investigated increased approximately 2 percent for every degree increase in gravity between 32 deg. and 40 deg. A.P.I.

As stripping of the fat oil is the opposite of absorption, the lighter oil is more difficult to strip. Only plants equipped with modern stripping equipment should attempt to use the very low molecular weight oils, for the reason that although increased oil circulation will compensate for the lower absorption efficiency of heavier oil, there is no complete remedy against inefficient stripping; the only partial compensating factors being high-pressure absorption and adequate cooling of the lean oil.

(6) The absorption factor as stated in (3) above is an inverse function of the vapor pressure of the individual component to be extracted. Because the absorption factor is dependent on oil temperatures, perhaps in the minds of some there may be a question regarding which of the temperatures, inlet or outlet, is the more significant. Obviously it is very important that the correct temperature should be used. According to Kremser, when the absorption factor is below unity, the equilibrium at the bottom of the absorber will control. With large absorption factors, the top temperature will be more indicative of the degree of extraction. Conservative practice recommends that the outlet oil temperature be used, however, in which case operating conditions will actually be somewhat more efficient than indicated by the computations.

(7) The absorption factor is directly proportional to both the absolute absorber pressure and the oil ratio. This does not hold exactly true under certain conditions. For instance, if the pressure is doubled, the increased saturation of the rich oil would cause a corresponding increase in absorber bottom temperature, which in turn would prevent the absorption factor from increasing in direct proportion to the increased pressure. Conversely, if the oil

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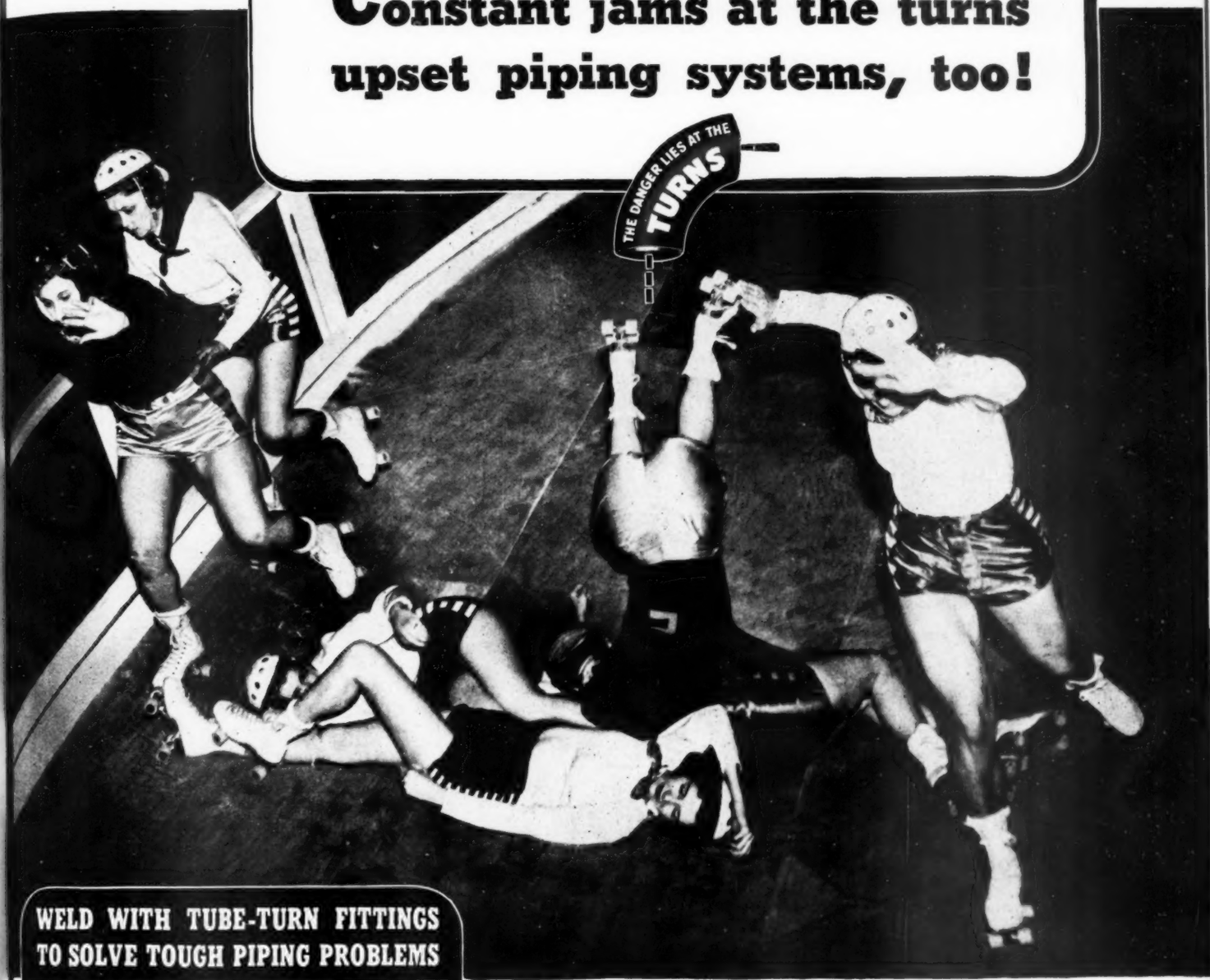

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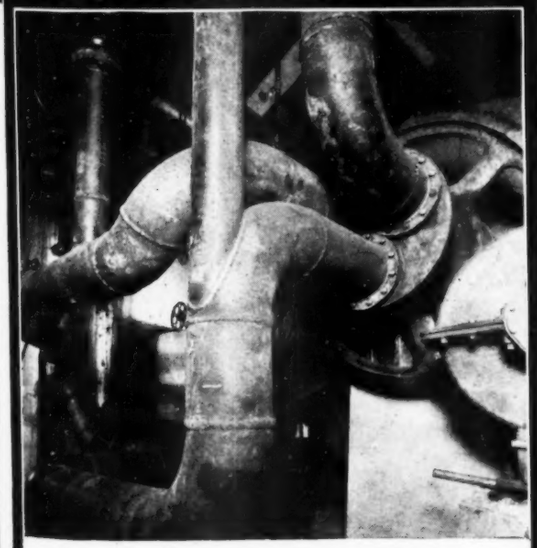

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ratio is doubled at constant pressure, i.e., with no change in pressure, then the absorber bottom temperature will be lowered, and a somewhat higher absorption factor will be obtained than that computed by direct proportion.

Therefore, proper allowance should be made for the effect of absorber bottom temperature on absorption factor, particularly at high-pressure plants.

Practical Considerations

A. A general survey should be made of plant equipment now in use.

(1) Number of trays in absorbers.
(2) Present operating pressures, and the possibility of raising absorber pressure.
(3) Oil circulation equipment, and the possibility of increasing oil rates, either at present absorber pressures or at higher pressures.
(4) Lean oil temperature at inlet to absorbers. Possibilities of providing more adequate cooling with existing equipment by means of cleanout work, alterations in cooling tower, water distribution, or other means that may be suggested by the inspection.
(5) Lean oil saturation. Kremser's theory of absorption assumed a negligible saturation of the lean oil. Adequate means for thorough stripping of the oil should be provided, including measurement of the stripping steam and efficient laboratory control.
(6) Possibilities of providing additional compressor capacity for refrigeration work by transfer of load to underloaded compressors.

B. A general survey should be made of such idle equipment as may be found at non-operating plants, warehouses, and surplus materials yards. This survey should include absorbers, exchangers, cooling towers, cooling sections, gas-engine compressors, pumps, and the necessary fittings and other materials that might be required for installations at new locations.

C. One practical method of increasing the number of effective absorber plates is to place two absorbers in series. If each absorber alone has 12 actual plates, then in series the effect will be similar to that of one absorber having a total of 24 actual plates. In this arrangement the gas should enter No. 1 absorber at the bottom, pass out at the top, and enter No. 2 absorber at the bottom. The lean oil should enter the top of No. 2 absorber, countercurrent to the gas flow, and be trapped out at the bottom into a suitable surge tank. A pump should then be provided to transfer the partially enriched oil from the surge tank through an oil cooler to the top of No. 1 absorber. This arrangement provides inter-cooling, which will tend to remove the heat of absorption acquired in No. 2 absorber. The compensating advantages should more than offset the disadvantage of using an additional pump, which in most cases will be on comparatively light load, due to a low differential in oil circuit pressures between intake and discharge of pump.

D. Desirable properties in an absorption oil. Due to the complexity and variety of crude oils, it is almost impossible to obtain from any one of them an absorption oil that has every desirable feature.[12] Therefore, the following desirable properties of an absorption oil are listed according to their relative importance.

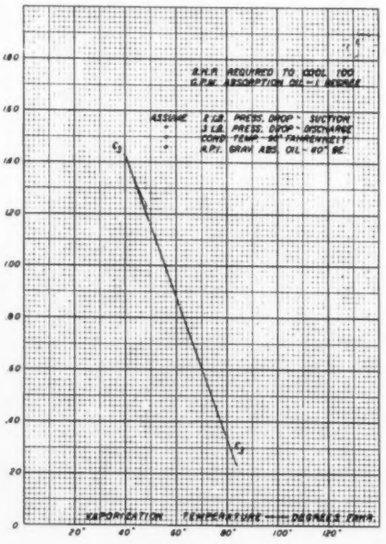

Fig. 2

(1) The molecular weight should be low, as absorption efficiencies increase with decrease in molecular weight of the absorption oil.
(2) The oil should have a low average boiling point.
(3) The boiling range should be short, i.e., about 100°F.
(4) The initial boiling point should be as low as practicable with the type of distillation equipment employed, but probably should not be below 400°F. in most cases.
(5) The gravity should be between 38 deg. and 40 deg. A.P.I. (See (5) under Section 2.)
(6) The oil should contain a low percentage of unsaturated hydrocarbons, due to their poor stability to heat and air. On the other hand, a high percentage of naphthene and paraffin hydrocarbons are desirable, as they are the best absorbents, and resist oxidation, or deterioration from heat.
(7) The oil should be free from organic acids and refining agents.
(8) The oil should have low pour and cloud tests. The pour point should be considerably below the lowest operating temperature.
(9) The oil should be sulphur free.
(10) The color should be 16 to 21 Saybolt as an indication of refinement.

E. Oil reconditioning stills. Regardless of how efficient a virgin absorption oil may be, it cannot maintain its original efficiency indefinitely when in use. On the other hand, by use of continuous rerun stills, the oil can be kept at a high percentage of its original efficiency.

Contamination of absorption oil is caused by foreign elements entering the oil circulation system. These include rust and dust from pipe lines, lubricating oil from compressors, and in some cases crude oil, due to oil separators overflowing and filling gathering lines with crude. The rate of contamination depends upon local conditions, and the efficiency of plant intake scrubbers.

Deterioration of absorption oil in actual use, according to I. N. Beall,[13] is chiefly due to oxidation and pyrogenesis. These two phenomena work together to produce sludge and gum, causing a lengthening of the distillation range, a decrease in effective oil ratio, and an increase in power consumption.

Several types of oil-reconditioning stills have been used. These include such early types as a small steel tank mounted in a brick furnace, or an oil-field type boiler, insulated and equipped to distill oil. Some plants have installed rather elaborate units, including fractionating columns and automatic controls. Others utilize a type that is similar in some respects to a scotch marine boiler, except that no return tubes are used; the hot gases passing through the firing tube only. In some instances the firing tube, or tubes, which may be one tube or more, is installed in the shell horizontally, and with modified Dresser connections for quick removal for cleaning. Others favor scrapers for cleaning the tube, or tubes. The scrapers fit around the tubes inside the shell and are moved back and forth by means of rods extending through stuffing boxes on the front head of the still.

At least two or more licensed types of[14] absorption oil-reconditioning system designs are available.

It is recommended that when the absorption oil is in very poor condition,

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and when heat exchange efficiencies are low, due to deposits on tubes in the oil circulation system, the entire system oil be dumped, and the system cleaned by means of circulating some suitable cleaning compound. In severe cases, it may also be necessary to remove the heads from exchangers and tube bundles for manual cleaning with augers and brushes. The system should then be filled with fresh virgin oil and operations resumed.

The oil rerun still should be started soon after resuming operations, in order to maintain the efficiency of the new oil as long as possible.

F. Absorber pressures. Although the absorption factor is directly proportional to both the oil ratio and the absolute absorber pressure, it is usually more economical to obtain an increased absorption factor by means of elevating pressures than by increasing oil rates. This is particularly true when a shortage of residue gas for fuel exists, or when the residue gas has a sales value.

In most plants now operating at absorber pressures of less than 50 lb. gauge, it will be found that these pressures can be safely raised to 60 or even 75 lb. gauge. Before doing so, however, it would be well to check the safe working pressures of the equipment involved with the manufacturer, and in cases where corrosion is suspected, it would be advisable to make an internal examination of this equipment before increasing pressures much above present levels.

In some instances it may be found desirable to install high-pressure absorption equipment if such is available, particularly at points where residue gas is now being boosted into high-pressure lines. It was the writer's privilege recently to examine operating data from a plant[15] operating at 300 lb. gauge absorber pressure, and with oil rates sufficient to maintain outlet oil temperature at approximately 100°F. Low temperature analyses of the inlet and outlet gases were as follows:

INLET GAS		OUTLET GAS	
Component	*Mol. percent*	*Component*	*Mol. percent*
C_1	74.24	C_1	88.17
C_2	9.24	C_2	9.09
C_3	7.51	C_3	2.74
i-C_4	1.30	i-C_{4+}	0
C_4	3.03		
C_{5+}	4.68		
	100.00		100.00

Oil ratio in the above instance amounted to 30.8 gal. per M. cu. ft., and actual extraction checks reasonably close to a normal butane factor[11] of 2.71 for 100 percent extraction of *iso*-butane, and approximately 59 percent extraction of propane. Actual extraction of propane was 63.52 percent. This higher actual extraction bears out the earlier statement that when bottom temperatures are used in computing the absorption factor, the computations are conservative.

G. Refrigeration. In recent years, many operators have resorted to refrigeration as a means of chilling the lean oil, and in a number of instances refrigeration is being used to remove the heat of absorption from the oil, part way down the absorber, as well as chilling the lean oil entering the top of the absorber. Either method is an effective and comparatively simple and inexpensive method of increasing extraction efficiencies at the average gasoline plant. This is particularly true when idle or under-loaded compressor capacity exists. One of the liquefied petroleum gases is usually employed as the refrigerant. If possible, a reasonably pure

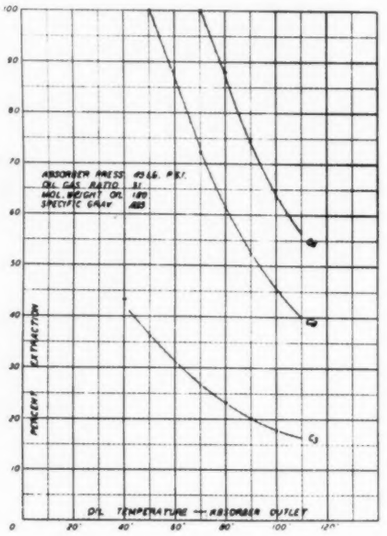


Fig. 3

hydrocarbon, either butane or propane, should be used, as the mixed hydrocarbon presents the bad feature of high condensation pressure as related to vaporization temperature pressure. This, of course, increases the ratio of compression and the horsepower required for any given B.t.u. extracted per hour.

As an example: A liquefied petroleum gas mixture, having a mol percent as follows: C_3—20 percent, i-C_4—30 percent, and C_4—50 percent, would have a vapor pressure of 85.6 at 100°F. Pure normal butane, of course, would have only 52 lb. absolute at 100°F. If we vaporize these refrigerants at 60°F., the pressure on the vaporizer, i.e., compressor suction, will be approximately the same in both cases, or 26.3 lb. absolute, because it is necessary to lower the pressure to a point where the heaviest component in the mixture will vaporize at the vaporization temperature; however, the pressure required to condense the liquefied petroleum gas (LPG) mixture will be 85.6 lb., or 33.6 lb. higher than for pure butane. The compression ratio for the LPG mixture would be 3.25, whereas that for pure butane would be 1.98. The difference in horsepower required, per 1,000,000 cu. ft., would be approximately 28 hp. greater for the LPG mixture than for the pure butane.

In many cases, great improvement in extraction efficiency can be obtained with refrigeration equipment salvable around most plants. The same conditions prevail in cooling absorption oil by refrigeration as apply to any other efficient heat transfer. It is desirable to pass the oil through the tubes of the cooler in order to obtain turbulent flow. The ebullition of the refrigerant helps to maintain turbulence in the shell of the cooler and obviates one of the problems of heat transfer.

It might be mentioned here that any cooling done by refrigeration must be offset by additional cooling load on condensing equipment equal to the B.t.u. per hour handled by coolers, plus the heat of compression; otherwise, the addition of refrigeration equipment adds to the total B.t.u. per hour load on the cooling tower.

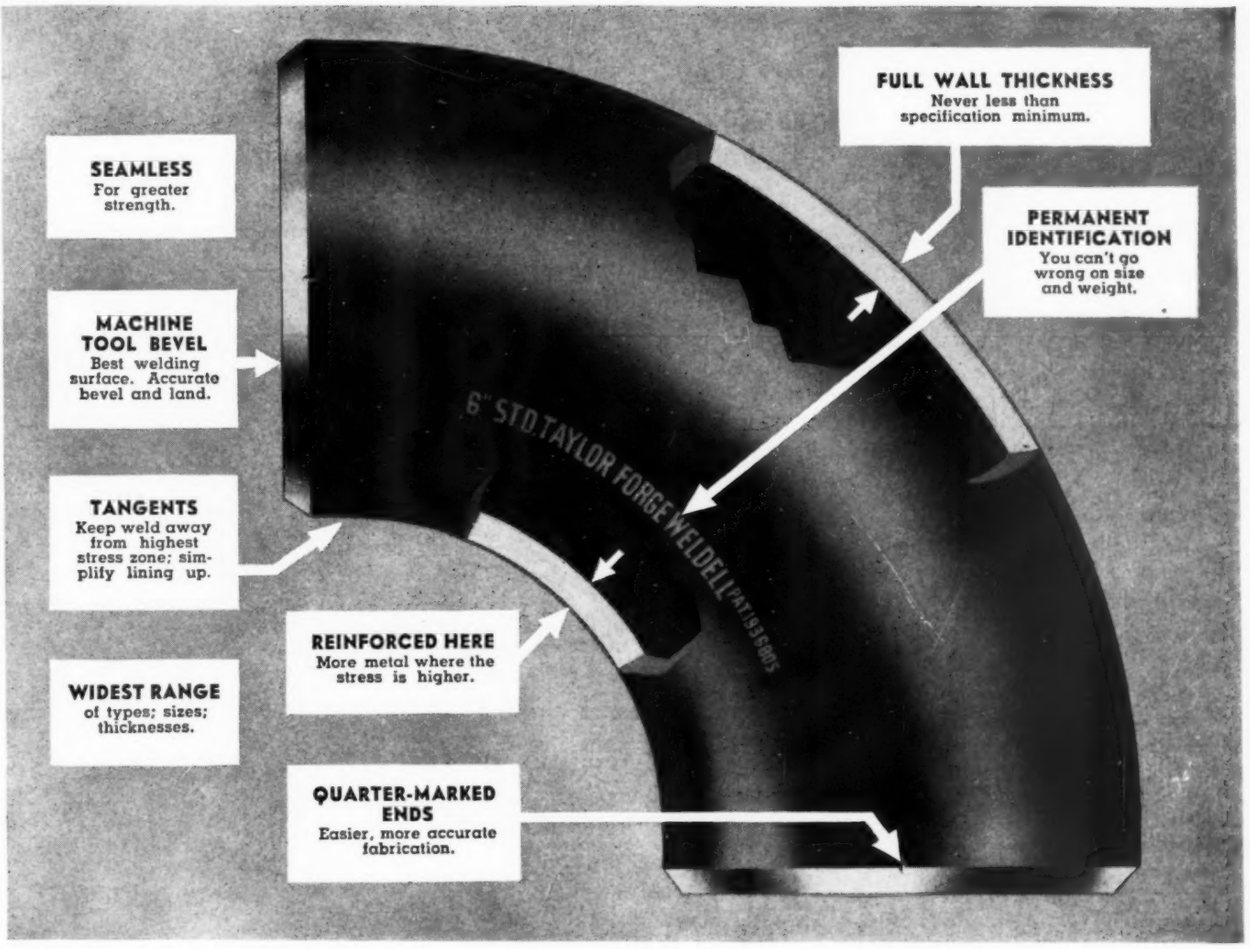
Self-explanatory charts[16] show graphically the horsepower required per 1,000,000 cu. ft. per day (Fig. 1), the horsepower required to cool 100 gal. per min. 1°F. (Fig. 2), and the increase in extraction resulting from lowering the absorption oil temperature. (Fig. 3)

H. Removal of light gases from the fat oil. So far this discussion has been principally concerned with the actual extraction of the liquefied petroleum gases from the gas processed in the absorber. It should be remembered that with the increased absorption factor required for maximum extraction of butane, the absorption of propane, ethane, and methane will also increase. The presence of larger quantities of these high vapor pressure components in the fat oil amplifies the problem of maximum recovery of the butanes from the oil.

Some methods for reducing the C_4 losses on the condensing and fractionating and of manufacture include:

(1) De-ethanizing the fat oil by means of an oil fractionator.

(2) A series of pressure step-down vent tanks installed so as to vent, as closely as possible, the methane and ethane from the first tank. The retained methane and ethane, a large portion of the propane, and some amount of the heavier fractions might then be vented from the second and lower pressure tank to a re-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absorber. Vapors from the third or low-pressure tank might enter a recompressor, or possibly the vapor condenser on the distillation unit.

I. Follow-up on operations. For best results in operation, it is essential that proper follow-up be made daily of all pertinent operating data. This should be the duty of a competent and experienced engineer, familiar with the design and operating conditions of the plant or plants under his observation.

It has been suggested that the Technical Committee of the N.G.A.A. be assigned the problem of determining the most essential data for intelligent analysis of plant operations for use by the industry. This would also facilitate the interchange of ideas within the industry, in our all-out effort to supply sufficient liquefied petroleum gases for the war program.

Economics

The question naturally arises: How far can the natural gasoline operator go in adding investments, increasing his operating costs, possibly rerouting his processing steps, all to squeeze the last gallon of the butanes from his gas? The economic limits will vary with the individual plant, and there is considerable difference of opinion on just what these limits are. Unless the operator has some definite idea of prices in advance, he cannot make a reliable estimate of the expenditures he can justify. As a liquefied petroleum gas fuel, butane has not been too attractive to some operators, due to various reasons, including the difficulties in handling, storage, transportation, and price. As a raw material, essential in a chemical process to produce rubber, butane acquires new status. When Alden, Trimble, and McReynolds[17] describe the probabilities of using propane as the volatility agent for motor fuel, the new trend is plain.

When we debutanize normal blending grades of natural gasoline to obtain additional butane for chemical synthesis, the new base line is at least the value of natural gasoline. Starting with such a base line, the smaller operator can view his butanes as a liquid in a better light than when his only outlet for these components is a competitive fuel market.

In Germany, we are told, butadiene is manufactured by an extremely complicated process. Coal and lime yield carbide; carbide and water yield acetylene; acetylene and water yield acetaldehyde; acetaldehyde and lime yield aldol; aldol and hydrogen yield butyl glycols, and at long last, by a process of catalytic pressure treatment, butyl glycols are converted into butadiene. Of course this long and complicated method is due to the lack of adequate supplies of petroleum and its derivatives.

In our country, so amply provided with petroleum and natural gas, we have many short cuts to butadiene production. Of these shorter methods, the use of butane as the starting agent is certainly the shortest from the standpoint of speeding up the development and production of Buna-S rubber. For this reason, as well as the need of huge volumes for 100-octane gasoline and other war requirements, it is inconceivable that the use of butane for these purposes will be necessarily restricted because the economics of inequitable returns to the manufacturers of the butanes prevent their concentrating serious attention on the problem of effecting full butane recovery in liquid form. It is conceivable, however, that as the rubber program gathers momentum, it may become imperative that we recover all the butanes as a liquid from the gas processed, or at least within the limits of the equipment available.

Prompt attention to what will ultimately be necessary in new plant equipment, utilization of existing idle equipment, or change-over of equipment now operating, together with possibly better operating procedures, even though more costly, will enable us to determine without delay what we shall need in economical return to operate under maximum recovery conditions.

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P 306.

War Adopts Many Oil Exploration Methods

SOUND ranging to locate enemy artillery, listening devices to warn of the approach of aircraft and submarines, depth-sounding to determine the position of underwater objects, demolition of land and sea mines by radio or acoustical impulses, position finding and navigating, terrain clearance determination for planes—these are only a few of the war-time applications of the science that has been so successful in finding oil fields.

Oil men, accustomed to think of geophysics as a special branch of oil exploration only, may be astonished to learn that this many-faceted science has dozens of uses in war.

Geophysics to the oil man is the science of mapping the dips and curves of geological formations many thousands of feet underground by the reflection or refraction of echoes from man-made earthquakes, by magnetic readings, electrical well-logging, and many other means. Actually, the science of geophysics is one of the broadest, and concerns all the physical phenomena in, and the transmission of energy through, the earth, the water, and the air.

Meteorology is a branch of geophysics. So is radio. Both have their manifold added values in war time. But even the special tools of the exploration geophysicist who in peace time searches out oil fields assume extra importance in war.

Seismic (earthquake) phenomena are used to make foundation tests and locate construction materials for land fortifications, shelters, gun emplacements, harbor installations, air bases, highways, railroads, bridges, canals, and tunnels.

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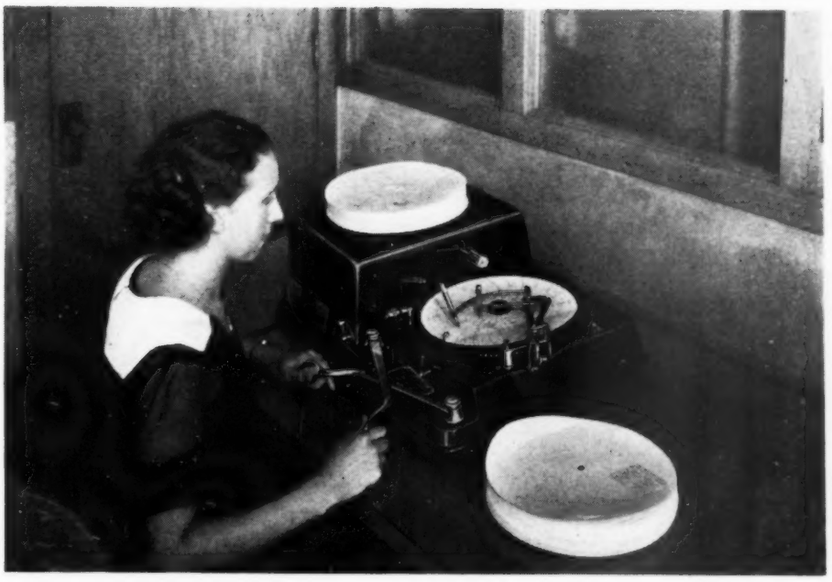

Fig. 1. An operator integrating orifice charts

Applying the Mechanical Integrator to Orifice Meter Measurement

PART 2 (Concluded)

by J. L. Cottrell

Manager, Integrator and Orifice Meter Division, Pittsburgh Equitable Meter Company

A photograph and biographical sketch of the author can be found on page 71 of the June issue of *The Petroleum Engineer* in connection with Part 1.

Procedure and Operation

Fig. 1 shows the integrating orifice charts in operation. The two control arm levers on the front of the machine cause the static and differential pens to move in and out across the face of the chart from the zero line to the extreme outer edge.

As the operator actuates the control arm levers, the static and differential cam roller arms must track the static and differential cams; and as these arms are directly connected by linkage arrangement to the pens that rest on the chart, the cam then actually drives the pen. The operator simply looks at the static and differential pens and manipulates the control arm levers so that each respective pen will retrace the curve originally recorded on the orifice meter chart.

The control arm handle operated with the right hand controls the differential pen, which is to the right of the operator; the left hand controls the static pen, which is to the left of the operator. This is true regardless of the make of orifice chart that is being traced.

The counter dial reading is written on the chart before the lines are traced, and when the tracing is completed, the pen arms are tilted back, the chart is removed, and the final counter reading is recorded. The difference between the start reading and stop reading is the extension or integration of the chart.

When the various ranges of charts have been retracted and the start and stop reading noted on the chart, a calculating machine can be employed to make the subtraction of the difference between the start reading and the stop reading; and in the case of a 500-lb.-100-in. chart, this subtracted difference is the total extension as the integrator is designed with a constant of 1.000 on that range.

For other ranges it is necessary to apply a machine constant, which is computed by taking the square root of one range over the other. For example, a 500-lb.-50-in. chart would have a constant of 0.707, which is the square root of ½; or a 250-lb.-100-in. chart would have a constant of 0.707, which is the square root of ½.

The constants on all McGaughy integrators are now the same due to all machines having the same gear case design; and as this constant is stamped on the machine and does not change, this constant may be multiplied into the orifice coefficient, then this factor may be multiplied by the subtracted counter reading on any chart, which will, for all intent and purpose, serve as the total extension. This procedure will eliminate the necessity of multiplying the machine constant by the counter difference to arrive at the total extension, then multiplying this extension by the orifice coefficient to arrive at the flow.

A continuous type counter is used on the integrator, which is similar in theory to the continuous counter on a displacement gas meter. This counter trips over on a reading of 10,000. This continuous counter makes it possible to take the addition of the subtracted differences on any group of charts traced, and the difference between the original start reading and the stop reading on

Fig. 2. View of the static cam assembly showing cams designed to correct for supercompressibility

the charts traced should equal the totalization of the accumulated differences on that group of charts.

With this method of balancing out and checking the operator for possible transposition of figures, and by glancing at the chart to make sure that the original static and differential lines were properly traced with the integrator pens that superimpose an ink tracer line over the original chart record, a definite check is had on the machine readings and the ability of the operator properly to retrace the chart.

The integrator should be checked at least once a day or each time pen arm assemblies are changed. This may be accomplished by setting the static and differential lines and retracing these constant values for the complete revolution of the chart.

When the integrator is set with the static range hole pin in the 500-lb. range hole, and a 500-lb. – 100-in. chart is used, the subtracted counter reading, when tracing any combination of perfect circle tests, should equal a known extension within 1/10 to 3/10 of 1 percent. When integrator is tested in one setting of static pressure, it is not necessary to test for other ranges. Some variation should be expected, however, due to the effect of humidity on the chart and slight errors in tracing the perfect circle values by the operator. The square root cams on the integrator are calibrated with the carriages locked in a given position, which eliminates tracing errors and are calibrated to within 1/10 of 1 percent of the theoretically perfect values.

There are some types of charts that cannot be handled by the set back pen method. The Westcott M-30 chart is a combination 30-in. vacuum – 0 – 20-lb. pressure. As this range is not a uniform curve, it is necessary to use an extra static cam for this particular range. The curve of the cam in this case would break at the zero point, one side of the curve being for pressure and the other side for vacuum. The machine can be changed for this range by shifting the cam range indicator so that the static cam arm tracks on the M-30 cam. For the Foxboro non-uniform or so-called old style chart, it is necessary to use separate static and differential cams in order to take care of the variations in the graduations on the chart. The zero and upper limit positions of this cam would be the same as the uniform cam, but the cam would be slightly larger through the center in order to take care of the variation in chart scale. When this type of chart is to be calculated, the cam range indicator can be shifted so as to make the static cam arm and differential cam arm track on the non-uniform cams.

During recent years, certain basic design changes have been made in the integrator so that the static cam assembly can be moved from the static carriage. This makes it possible to supply any number of static cams graduated in the various zero to upper limit static scales designed to correct for supercompressibility or the deviation from Boyles' Law. This correction can be incorporated in the static cam for any average gas of a certain specific gravity and temperature.

With the interchangeable static cam assembly, it will be possible to supply any number of cams for various static ranges and various types of gas that would have to be measured on a pipeline system. When the correction for supercompressibility is made in the static cam, it necessitates a separate cam for each zero to upper limit static scale as this correction changes the curve of the uniform cam used with the set back pen method for reading charts not correcting for supercompressibility. The incorporation of the supercompressibility factor in the static cam on the integrator eliminates applying this correction to the orifice coefficient and is more accurate in cases where the static pen on the meter shows an appreciable amount of variation.

With the interchangeable static cam arrangement, it is possible to supply cams for all static ranges of charts for the Emco, Foxboro, and Westcott meters on one machine. Shifting mechanism is also designed to allow the static cam roller arm to track any range static cam when the supercompressibility type cams are placed on the machine. Fig. 2 is a photograph of the integrator designed with folding mechanism cover and shows a view of the static cam assembly designed to correct for supercompressibility.

Any Emco orifice chart, Foxboro uniform or so-called new style, or Westcott chart, with the exception of the M-30, can be calculated on the uniform cams so long as the static range scale is not below 0 – 50 lb. For lower ranges it is necessary to use an extra cam for that particular range. The various crank arms that operate the pen assemblies are all linked and geared together so that the same uniform static and differential cam can be used for all uniform charts. Gears are used to speed up the pen's movement across the chart in proportion to the increased radius of the Foxboro chart as compared to the Westcott chart, and linkage is used from the Foxboro chart to the Emco chart for the same purpose. By connecting the three pen movements in proper ratio, it is not necessary to use separate static and differential cams for the three different makes of uniform charts, thereby simplifying the construction and operation of the machine. Each set of pen arms for the three different makes is so designed that the differential pen follows the arc line on that chart and the static arm is made up to take care of as many static ranges as desired for that make of chart.

There are a number of orifice meters

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Fig. 3. Multiple cam machine of the three-way type

in use where two separate gauges are used — one for recording the static pressure and the other for the differential. Some of these installations have a static chart that is smaller in diameter than the differential chart.

A chart transcribing machine has been developed for the purpose of transferring the static record from the static chart to the differential chart in direct proportion; in other words, when the static pen is resting on any graduated line on the static chart, it automatically transfers this static to a corresponding line on the differential chart. This transfer of static record to the differential chart is accomplished by means of a cam that is calibrated to give an exact reproduction of the static chart to the differential chart. When both records appear on the differential chart, it may be integrated in the same manner as charts that were originally recorded with both the static and differential lines on one chart.

There are cases when an orifice meter will be found in error when the meter is inspected. For example, the static or differential pen may be off zero. Quite often the differential pen is found slightly low, due to loss of mercury. Charts may have been recorded from a meter that is in this condition for some time, and when the meter is found in error and the amount of the error reported to the office, the question then is to calculate that chart correcting for the amount of error existing in the meter.

If the differential varies throughout the range of the chart, to apply a correction for the percentage of error is entirely wrong due to the variation in gauge capacity from zero to the upper limit of the chart. A set of dividers fitted to a pen cap can be placed on either the static or differential pen and the divider point adjusted so that it does not quite touch the chart. Then the distance between the tip of the divider and the tip of the integrator pen can be adjusted to correspond to the amount that the meter was found in error. Then the line that is recorded by the meter can be traced with the tip of the tracing pen divider, and the integrator will integrate and record a line where the meter should have recorded. In this way, an accurate, corrected reading is obtained, regardless of how much the differential or pressure may fluctuate.

In cases where wide range combination gauges are used, that is a 20-in. and a 100-in., or a 10-in. and a 50-in., usually there is no pressure element in the 10-in. or 20-in. gauge. To calculate these charts on the integrator or by any other method, it is necessary to transfer the static from the 50-in. or 100-in. chart to the 10-in. or 20-in. chart. To calculate these combinations on the integrator, the static from the 50-in. or 100-in. chart should be transferred to the 10-in. or 20-in. chart by first placing on the integrator the chart to which the static record is to be traced. Then lay a sheet of high-grade pencil carbon paper over the chart. Then place the chart with the static record on the chart in place and match the two charts hour for hour. A small metal stylus is slipped over the static pen, then trace over the static line on the 50-in. or 100-in. chart and transfer this record to the 10-in. or 20-in. chart exactly as it appears on the chart that was originally recorded by the meter, as both of the charts are matched up exactly for time, and are held from exactly the same center. Then both the 10-in. or 20-in. chart and the 50-in. or 100-in. chart can be calculated, as each chart now has a static record.

The time indicator can be set so as to calculate the number of hours to be calculated on the 10-in. or 20-in. chart. Then calculate the number of hours on the 50-in. or 100-in. chart. This method would be used where the differential is readable for any continuous length of time on the 50-in. or 100-in. chart. The reading can then be used on the 10-in. or 20-in. chart for the remaining length of time that was not read on the other chart. In cases where the differential fluctuates quite rapidly from zero to the upper limit first on one chart and then on the other, the 50-in. or 100-in. chart should be read for the portion that exceeds the upper limit of the 10-in. or 20-in. chart, and when it is below the upper limit of the 10-in. or 20-in. chart, push the differential pen to zero, which will stop the counter as this reading will appear on the 10-in. or 20-in. chart. Then read the 10-in. or 20-in. chart where the differential is readable on that chart, but never go above the upper limit of the 10-in. or 20-in. chart, as that reading has been calculated on the 50-in. or 100-in. chart.

When the differential exceeds the upper limit on the 10-in. or 20-in. chart, push the differential to zero as when running the 50-in. or 100-in. chart. The machine constant can then be applied to each of the respective differential ranges and the coefficient applied to each of the extensions.

When the square root chart is used, the coefficients on the two charts would be different. On standard scale meters the coefficient would be the same, and in that case, the two extensions could be added after the machine constants have been applied, and in that way eliminate one multiplication of the orifice coefficient by the extension to arrive at the flow.

Square root charts are based on a constant of 1.0 on a 100-lb. – 100-in. range. When integrating this chart, it is necessary to put the pin in the space provided on the static pen arm for square root charts. Trace the chart in the usual manner and multiply by the square root constant, which, incidentally, is the same as the standard 100-lb. – 100-in. range on the integrator. This constant can be multiplied by the subtracted counter reading in the usual manner to arrive at the flow. The orifice coefficient is computed for square root charts in the same manner, regardless of what method is used in calculating the chart.

When computing orifice meter charts that are measuring liquid, it is necessary to integrate the differential

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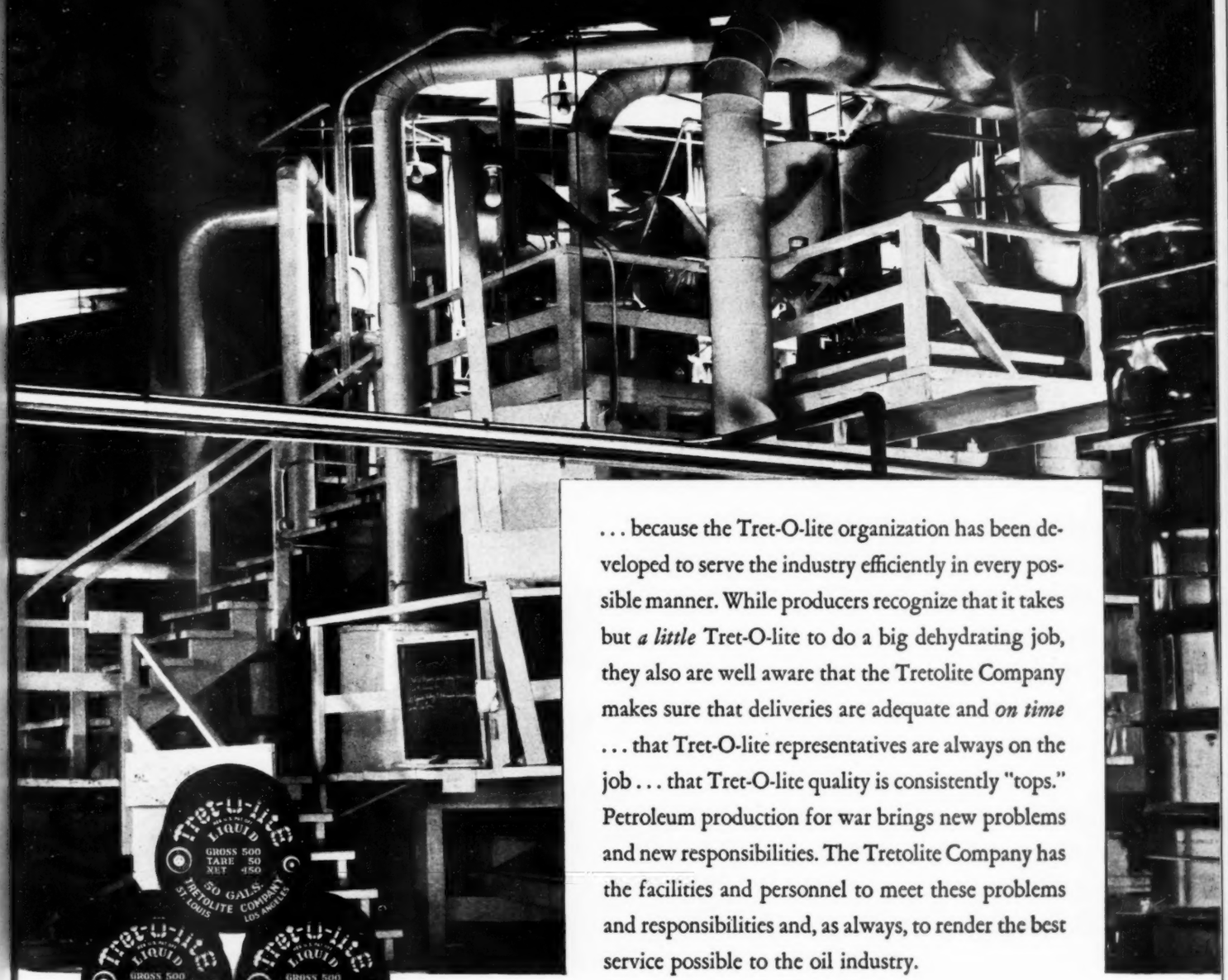

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DEHYDRATING **DESALTING**

Fig. 4. Integrating mechanism showing time plate, static carriage roller, and pressure plate

only, as liquids for practicable purposes are not compressible, and no static pressure reading is required. To integrate orifice meter charts measuring liquid, trace the differential as shown and hold the static pen on some constant perfect circle line, then take the square root of the static pressure line traced and divide this figure into the integrator constant that corresponds to the static and differential ranges of the chart being considered. For example, to integrate a square root chart measuring liquid, the static pen would be held on the 7-line for the entire revolution of the chart; and in the case of a 24-hour chart, then multiply 7×24, which would give a total static value amounting to 168. Dividing this by the integrator constant, which is 0.447, would give a corrected constant for square root charts measuring liquid of 0.226. This constant multiplied by the subtracted counter difference, would then give the extension as recorded by the meter.

When charts measuring liquids are to be computed and the charts are graduated in lb. of pressure and in. of water, use this same procedure of tracing a constant static pressure value for a 24-hour period. It will be necessary to take the square root of the gauge pressure plus atmosphere into the integrator constant, which would correspond to the static and differential range being read, which would accomplish the same result as outlined in calculating the square root chart when measuring liquids. The square root of the static value traced for the entire chart could be divided into the counter reading and the standard integrator constant applied to that result. Dividing the constant by the square root of the static value traced, however, will eliminate one calculation in arriving at the total flow.

To arrive at the average pressure on orifice meter charts for the purpose of determining supercompressibility factors, this same procedure may be reversed, that is, hold the differential pen on a constant perfect circle value, and trace the recorded static line, and the square root of the differential traced for a perfect circle value may be divided into the integrator constant. The constant will, of course, vary, depending on whether a square root chart or a chart graduated in lb. of pressure and in. of water is used. This procedure would apply to cases where supercompressibility factor is applied to the orifice coefficient and not taken into account on machines having this correction incorporated in the static pressure cams.

In Figs. 3 and 4 are photographs of the integrator with the case removed from the integrating mechanism. Fig. 3 shows the views of a multiple cam machine of the three-way type. Fig. 4 shows the cover removed from over the integrating mechanism, which reveals clearly the time plate, static carriage roller, and pressure plate, and other mechanism.

One can become quite adept at operating the machine in a day's time and can, with a few days' practice, integrate from 250 to 300 or more average 24-hour charts per working day.

The ratio of efficiency of the integrator over observation methods is from three to five times faster, assuming that the person making the observation reading averages the static and differential at least hourly, making the extensions, adding these extensions and rechecking the calculations or giving the same result that is obtained by retracing the static and differential lines with the integrator, and making the counter dial subtraction to arrive at the total extension.

Most companies using integrators base the machine life over a period of from five to ten years. This life, of course, depends on the type and number of charts being computed.

The mechanical integration reading of charts is generally recognized as the most accurate and economical method of calculating orifice meter charts.

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Science Beats Guesswork Finding Oil

Science beat guesswork by more than five to one in finding new oil fields in 1941, the best record made since figures have been kept, according to the American Petroleum Institute.

One out of every five wells drilled last year on the basis of technical advice in the hope of finding a new oil field was successful. Only one of every 27 that was drilled because of a hunch, a doodle-bug, or some other non-technical reason found oil.

Scientific exploration is used in locating most wells in unproved areas today. A single oil well costs anywhere from $25,000 on the average up to $150,000 and more, and even with the help of science the chance of finding oil is only one to five.

Geology, geophysics, geochemistry, or some combination of these scientific methods of mapping underground structures was used in determining the location of 2399 of the "wildcat" wells drilled in 1941, and 471 of them found oil. Guesswork or some non-technical reason led to the drilling of 801 wells, of which only 30 were successful. Altogether the industry drilled 3264 wildcat wells; the reason for drilling 64 of them, two of which found oil, is not known.

Normally about one-tenth of all wells drilled each year are wildcat wells, or wells sunk in the hope of finding a new field. Most wells are drilled to develop fields that have been found. This year, however, the total number of wells drilled will drop to a little more than half the 1941 total because of the shortage of steel.

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Our workers in the Bartlett Hayward Division at Baltimore are now privileged to wear this emblem, a mark of unusual honor and distinction.

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This award was recommended by the *Bureau of Aeronautics.* Only two other American industrial concerns have been so honored. It was given because of ingenuity in applying straight-line, mass-output methods to the production of catapults for launching airplanes from the decks of naval vessels, and because of substantially bettering scheduled deliveries.

We are proud of these employees whose unceasing efforts have been so dramatically recognized, just as we are proud of those who are now serving in the armed forces. This war is being fought in the factory as well as on the battle-front. Both jobs must be *well done.*

All over the country, thousands of fellow-employees in the Koppers organization are likewise engaged in helping to arm America. They are building by-product coke plants and processing plants, producing coal and its innumerable derivatives, coke, chemicals, treated timber products, piston rings, special metals, fabricated parts and other materials and implements needed in titanic quantities by The United Nations. To each of them, this Navy "E" will bring added inspiration and a new appreciation of the vital importance of his share of the job.

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P 625.3
P 514.2
P 749.1

Useful Devices for Operators in Natural Gasoline, Natural Gas, and Allied Fields

☆ Practicable "Gadgets" and "Operating Kinks" presented at annual contest of California Natural Gasoline Association

SOME very useful "gadgets" and "operating kinks" adaptable to the natural gas, or allied industries were presented in the annual Gadget Contest held during recent meetings at Los Angeles and Taft of the California Natural Gasoline Association. The gadgets consisted of new devices, tools, implements, or parts of equipment designed to do a job in a faster, safer, easier, or more profitable way; the operating kinks were new or improved ways of doing an old job by rearrangements or different uses of existing tools, equipment, or devices. No device or method already on the market was eligible for the competition.

Prizes were awarded on the basis of "originality, utility, time saving, labor saving, and health feature of the gadget or kink." There were 42 entries, each accompanied by drawings and/or photographs and complete descriptions of construction and operation that are now on file at the headquarters of the California Natural Gasoline Association, 510 West 6th Street, Los Angeles. Complete details of all that are listed below can be procured from the association. Those awarded prizes are indicated by an asterisk.

This unitized orifice meter header requires a minimum of readily obtainable fittings, provides combination drip and mercury pots in single unit, is light, can be moved with the meter as a single unit and spaces the valves conveniently with protection under the hood

1. Oil pump to eliminate sucker rods and surface lifts for the rods. Entered by G. R. Morris, Union Oil Company.

This device has been designed to effect a quick shut-off of any broken steel main. It was developed for air defense work to shut-off fires or leaks that might become beacons for further attacks if allowed to burn

*2. Emergency steel-pipe shut-off device to shut-off flow through a steel pipe if broken when no valves are installed. Can be installed on pipe line and will pinch pipe; is closed by hydraulic pressure. Entered by C. F. Briscoe, Southern Counties Gas Company.

3. View plug to permit inspection of orifices under pressure in gas lines, particularly those existing under old installation of drip or service connections to main. The view plug consists of a 1½-in. transparent pipe plug provided with a square head for hand tightening. Entered by J. R. Brick, Southern California Gas Company.

*4. Balanced valve vibration dampener to prevent untimely "wearing out" of balanced valve plug drive linkages as a result of excessive plug chatter. The inertia of the valve plug is increased by attaching thereto a heavy piece of shafting that is housed in a suitable valve body extension. Entered by R. B. Ward, Standard Oil Company of California.

*5. Motor valve dampener to retard the speed of reaction of a motor valve to its controller as a means of preventing over-control. The device consists of coiled tube (orifice) so arranged in a reservoir that controller power is transmitted to the motor valve hydraulically by movement of oil in the tube. Entered by R. B. Ward, Standard Oil Company of California.

6. Demountable operating nut wrench to turn operating nuts installed on the stems of underground gate valves. This wrench, for operating gate valves, assembles to about a 5-ft. length. It breaks down into 2-ft. 8-in. sections or shorter for transportation convenience. Sockets are provided for up to 6-in. gate valves, hand wheels, or lubricated plug valves. Entered by L. L. Biggs, Southern California Gas Company.

7. Emergency pipe stopper to stop flow in gas pipe lines after a break during an air raid. A rubber stopper mounted on a long 1¼-in. pipe pole,

...S ... Order ...

THAT HARD-SHOOTI...

McCullough GUN PERF...RATOR

GUN PERFORATORS

Comp...
SERV...
UNITS & ...
OIL FI...
MEN ...
YOU ...
MCC...
SERVIC...

GREATER PENETRATION

Maximum powder charge within the capacity of the Gun combined with scientifically controlled confinement of the gases give the bullet extremely high velo... ...clean holes, deep pene... ...and maximum fractur... ...ations.

SIMULTANEOUS FIRING UNIFORM HOLE SPACING

All shots are fired at once ... the Gun is stationary at the ... sired point in the well. Holes ... through the casing are spaced ... exactly as are the chambers in the Gun body.

GREATER RANGE OF BULLET SIZES

Standard size bullets are ¼", ⅜", ½", ⅝" and ¾" diameter. Special McCullough Guns fire ⅛", 1", and 1¼" diameter bullets.

ACCURATE LINE MEASUREMENTS

The McCullough Line ... ...accumulator ... ...Proved to be the most accurate and reliable line measuring means known.

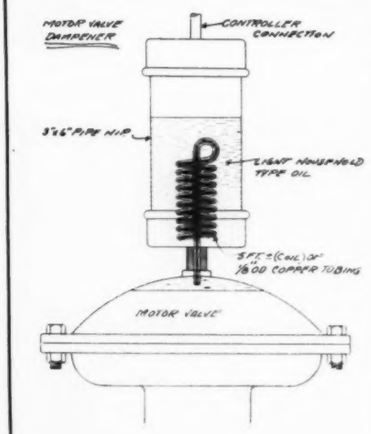
COMPLETE QUADRUPLE SAFETY-CHECK

McCullough Gun Perforators are SAFE—on the surface and in the well. They can fire only at the desired point in the well.

GREATER RANGE OF GUN SIZES

McCullough Gun Perforators are ... 4¼", 4¾" and 6⅜" O.D. Guns shoot ... shots in a five-foot section. Several ... be joined together to shoot as many ... single run as required.

In unloading pipe onto a pipe rack the ends will not line up and clear driveways properly unless made to do so. With this roller it is only necessary to roll pipe up on the roller and roll endways into position with little effort, even with the heaviest pipe



This device retards the speed of reaction of a motor valve to its controller as a means of preventing over control. Severity of dampening may be readily altered by dilution of oil in the reservoir

reinforced by a wire brush on either side, is inserted into a broken end of the pipe line to shut off gas flow. This is especially useful for cast-iron pipe. Entered by W. M. Henderson, Southern California Gas Company.

*8. Broken pipe thread remover to remove broken-off pipe threads without injury to female thread by grinding threads off old pipe tap and relieving for left-hand rotation. Entered by R. S. Pridham, Standard Oil Company of California.

9. Floating drill for removing coke, etc., from tubes and pipe without damage to tubes. This is a floating oval-shaped drill that has no sharp corners to injure tubes. Entered by R. S. Pridham, Standard Oil Company of California.

10. Extension for boiler flue roller to enable one to roll leaky tubes in hot boilers. A universal joint is welded between two pipe couplings. One coupling slips over the roller mandrel, the other holds an extended 1-in. pipe with cross and nipples for turning. Entered by John Webster, O. C. Field Gasoline Corporation.

*11. Method of coiling hose without kinks to make hose, wire rope, etc., coil easier and come away without kinks. Entered by R. S. Pridham, Standard Oil Company of California.

*12. Smyser stuffing-box to pack-off the polished-rod. Entered by E. D. Smyser, C. C. M. O. Company.

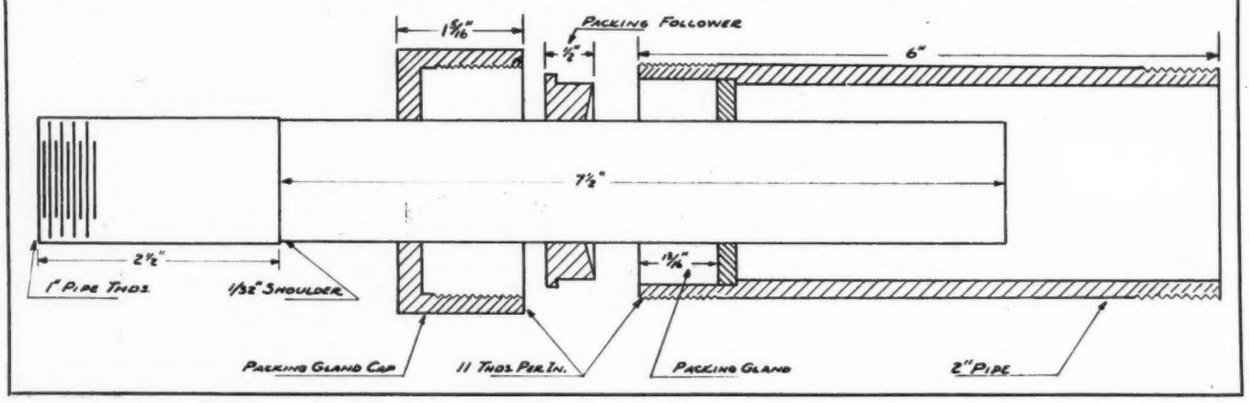
13. Slip tube stopper to hold gauge tube at any given point in butane tank. Entered by F. LaGraffe, Union Oil Company.

14. Oil displacement meter with totalizer and sampler for metering and sampling oil direct from gas trap to tanks. This is a new type all-rotary displacement meter now being tested for use where scale and sand is present. Entered by H. E. Wood, Automatic Liquid Meter Company.

*15. Flexible caliper for calipering inside chambered cavity having small opening where ordinary caliper cannot be used. This equipment consists of a 1/8-in. brass pipe with a 1 1/2-in. radius bend on lower end; a heel brazed on the lower end of tangent 1/4-in. lock screw on handle with spring inserted in pipe for adjustment for measuring. Entered by E. L. Schmidt, Standard Oil Company of California.

*16. Saftey gas shut-off valve for rectified charcoal test apparatus to eliminate hazard of blowing-up charcoal still. The valve consists of a plug cock having ring groove and sleeve with fuel gas inlet and outlet ports. The plug cock is keyed to the valve that shuts-in the condenser coil. With the valve in a closed position, the ring-groove offsets gas ports in the sleeve shutting-off gas to the burner. Entered

Gasoline meter connection. The construction of this adjustable connection for displacement meter installation is evident from the drawing



GETTING "SOFT" ... EH?

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

"BEWARE of an America aroused!"

Sure we've been rolling on rubber—eating our sirloin steaks—lolling in the luxuries which only free Americans have the God-given genius to create, and the capacity to enjoy. But we can still take it, and we can still dish it out.

The world knows now that this "love of luxury" is just a thin outer garment, easily whipped off in an emergency—and that, underneath it, there are muscles of steel.

Sacrifice? We will sacrifice anything but our Liberty!

Suffering? We still remember about Valley Forge, and the blood of our fathers on the snow!

Death? Better death, any day, than life without freedom!

So they said we'd rather lose a war than lose an election? And those cracks, dividing us, were deep craters—not just surface scratches? Management wouldn't work with men, and men wouldn't work with management? And we couldn't get going *fast enough* to become a real factor in this war?

What a jolt the Axis is in for! You might just as well try to sweep the tide back with a broom as try to buck American machines, driven by free, skilled American workers.

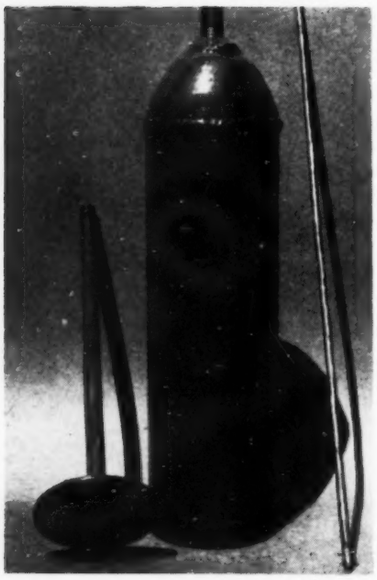
◆ ◆ ◆

Inspired by the job our own workers are doing, we view this crisis, not with alarm—but with confidence. Every lathe, every drill, every tool in our plants has been turned into a weapon of war—every worker, man or woman, into a PRODUCTIONEER—a soldier in overalls. Such spirit, such skill, such strength cannot lose—for these men and women are fighting *with their hearts*, as well as with their heads and their hands—fighting, along with the millions of other patriotic workers throughout all America—to STAY FREE!

LINK-BELT COMPANY—INDIANAPOLIS—PHILADELPHIA—CHICAGO—ATLANTA—DALLAS—SAN FRANCISCO—CEDAR RAPIDS
THE LEAD NG MANUFACTURER OF EQUIPMENT FOR HANDLING MATERIALS AND TRANSMITTING POWER

Reprints in 4 colors furnished on request. Address: 307 N. Michigan Ave. Chicago.

8100A Copyright 1942 by Link-Belt Company



The parts of a device used to lubricate a gas-engine bearing on a pumping well are here shown. The copper rod rides on shaft and extends through nipple and grease cup connected to the top hole of the bearing. The copper rod conducts heat from the shaft to the grease

by J. T. Hansen, Standard Oil Company of California.

17. Unitized orifice meter manifold to provide a unitized orifice meter manifold interchangeable between all Westcott types of meters; made up of standard pipe fittings, and embodying the advantages of "underslung" types with pots. Entered by Melroy Welch, Barnsdall Oil Company.

18. Barrel tilter to facilitate handling of oil drums and prevent injuries. A light rack made of angle iron and sucker rod; resembles an iron sled. Entered by Clyde Perry, Richfield Oil Company.

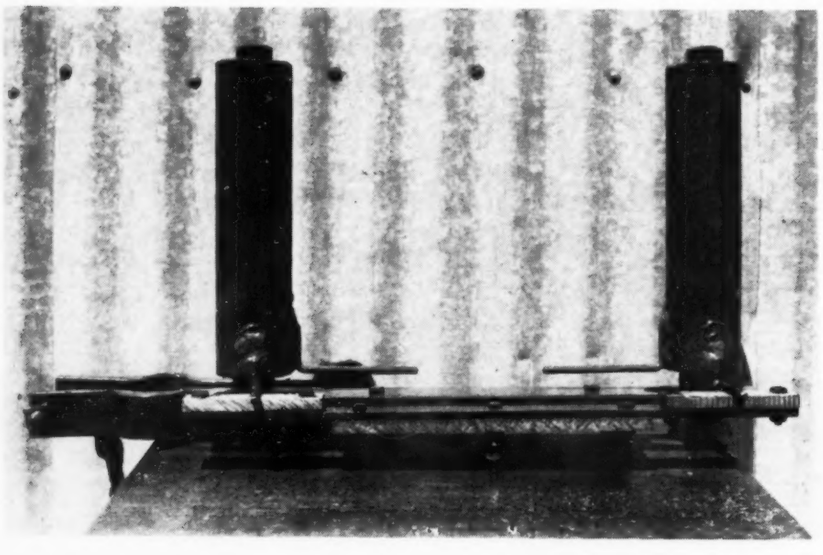
19. Electric cable shield remover to remove the metal covering from electric cables. An adjustable cutting tool is mounted on an angle-iron guide. The metal covering may be shredded lengthwise and also cut at right angles to the wire. A locking device holds the tool at any place desired. Entered by H. H. Jackson, The Texas Company.

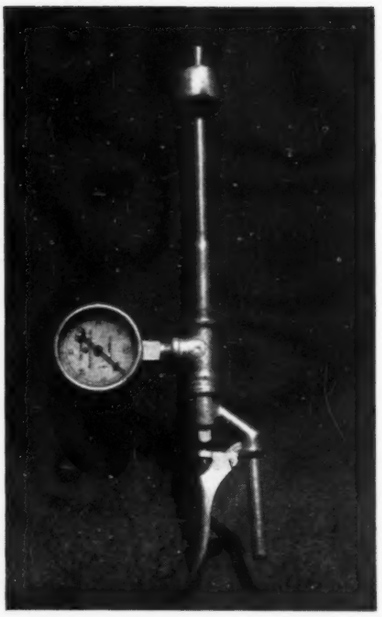
*20. Clock key to enable all clock springs to be wound to a uniform tension; prevents shaft and spring breakage. The key handle turns the key shaft through two friction washers. Tension is adjusted so that friction washers, acting as a clutch, will slip before enough tension is exerted on the clock spring or shaft to cause breakage. Entered by H. H. Jackson, The Texas Company.

21. Improved poppet valve cap wrench to remove caps more easily from compressor cylinder poppet valves. A square head fits into the recess in valve cap. Hexagon shoulder permits use of open end wrench for unscrewing cap. An extension provides a place to hold the wrench. Entered by R. G. Wren, The Texas Company.

22. Idler pulley aligner to align idler pulleys accurately. A "V" block forms the base of an adjustable shaft. The shaft is used to measure the distance between engine belt pulley and idler pulley. Entered by R. G. Wren, The Texas Company.

This device will short out or ground the ignition on a slow-speed gas engine on a pumping well. If the belt breaks or runs off pulley into clutch, the belt turns the guide post or hits the arm that turns the grounded connection





With this device, heating or cooling coils can readily be tested for leaks by two men. After removing ends to expose the tubes, one man plugs the opposite end of tube from operator who inserts plug into tube, turns on air or gas, and shuts off air or gas when pressure is 25 or 30 lb. per sq. in. If the pressure drops, the tube is bad; a hole the size of a pin will drop the pressure rapidly.

23. Steam whistle controller to sound steam whistle by remote control. A ½-in. (or smaller) solenoid valve controls power to diaphragm, which acts as moving force for whistle valve. Entered by M. B. Fraser, The Texas Company.

*24. Manometer liquid retaining trap to catch the water when the rate manometer on the charcoal distillation apparatus is "blown" and automatically return it to the manometer. The water is forced up the inner tube, deflected and collects in the space between the inner and outer tubes. When the pressure has become equalized the water will run through the small hole and back down the side of the manometer tube. Aerosol is used in the water to lower the surface tension and allow it to run freely. Entered by W. T. Switzler, Standard Oil Company of California.

25. Adjustable connection for displacement meter installation to facilitate installing and changing gasoline displacement meters. Entered by R. D. Wood, Honolulu Oil Corporation.

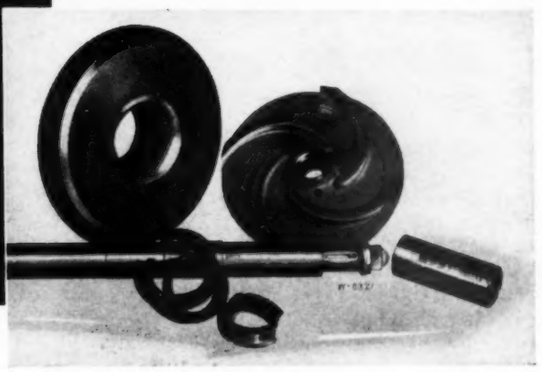
26. Return-bend bar to facilitate making up return bends. Keeps them from turning or slipping. Entered by H. C. Webber, Honolulu Oil Corporation.

WORTHITE PUMPS...*ideal for*

SALT WATER DISPOSAL

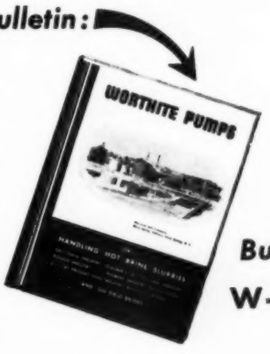
The corrosion resistance of Worthite* and its toughness is clearly shown by these photographs of the internal parts of a Worthite pump after a long service record handling hot brine slurry.

Worthite pumps on salt water injection service show the same absence of corrosion or wear.



Send for your copy of this instructive bulletin:

This new bulletin on Worthite pumps for handling various brines, contains information pertaining to the problem of SALT WATER DISPOSAL.



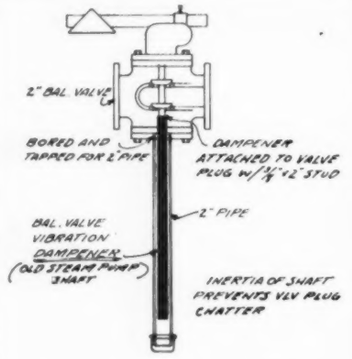
Bulletin No.
W-350-B6

***Worthite is a high nickel-chromium-moly alloy, now in demand for handling acids in war plants. Worthite pumps are available to those processors whose activities give them priority.**

CP2-6

WORTHINGTON

WORTHINGTON PUMP & MACHINERY CORPORATION • GENERAL OFFICES: HARRISON, N. J.


2" BAL. VALVE
BORED AND TAPPED FOR 2" PIPE
DAMPENER ATTACHED TO VALVE PLUG W/ 1/4" 12" STUD
2" PIPE
BAL. VALVE VIBRATION DAMPENER (OLD STEAM PUMP) SHAFT
INERTIA OF SHAFT PREVENTS VLV PLUG CHATTER

In some services, balanced valves have a tendency to chatter due to the venturi effect of high relative fluid velocity between the plug and its seat. This causes undue wear. Increasing of the weight, (inertia) of the plug, as shown, prevents rapid motion of the plug and permits establishment of equilibrium between the plug and drive linkage forces, thus eliminating period vibration and consequent wear

27. Hill portable gas gravitometer for rapid, accurate field measurement of specific gravity of gas. A practicable, low-cost, light-weight instrument that indicates the specific gravity of gas by use of sound produced by a vibrating column of gas. Entered by D. C. Hill and W. A. McGlashen, Southern California Gas Company.

28. Hill micro-pressure indicator to measure accurately low gas pressure and vacuum. The instrument consists of mechanical means of measuring the pressure or vacuum in a closed vessel interconnected to an open chamber by measuring the change in water level caused by pressure change in the closed vessel. Entered by D. C. Hill, Southern California Gas Company.

*29. Pipe roller to line-up pipe when stacking on pipe rack. Two rollers are mounted in a frame with needle bearings so pipe may be rolled onto rollers and moved endways into position for proper stacking. Entered by C. H. Mercer, Union Oil Company.

30. Barrel lifter to stand up or lay down 50-gal. oil drums. Consists of a stick with suitable hook. Entered by L. M. Lundgren, Union Oil Company.

31. Mixer to mix "A" and "B" foamite solution when testing. Place mixer in bottom of a quart jar, which has been calibrated to 300 cc.; take a 5 cc. sample of "A" solution and a 25 cc. sample of "B" solution, with tips of pipettes in small holes in mixer; allow samples to flow together in mixer. Entered by T. T. Rissinger, Union Oil Company.

32. Automatic grease cup to lubricate gas engine bearing on pumping well, according to temperature of bearing, feed varying as temperature. Copper rod rides on shaft and extends through nipple and grease cup connected to top half of bearing. The rod extends through plunger inside grease cup holding ½ gal. cup grease, sufficient to last 6 months. The copper rod conducts the heat from the shaft to the grease regulating by temperature the amount used. Plunger on top of grease keeps out the dirt and is a gauge to the amount of grease in the cup. Entered by Elmer D. Smyser, C. C. M. O. Company.

34. Tube tester for testing tubes and pipe for leaks. Air- or gas-operated device for testing tubes in heat exchangers or cooling coils for leaks. Entered by J. L. Black, Coline Gasoline Company.

35. Gas line sample tap punch to punch a hole in a low-pressure gas line that can be tapped to ¼-in. pipe thread for taking sample from line. A sharp pointed steel punch, with handle welded on the top end. The small part of the punch is 29/64-in. dia. to take ¼-in. pipe tap. The punch is driven through the gas line with a 3-lb. sledge hammer. The hole is tapped with a ¼-in. pipe tap, ¼-in. nipple and valve screwed in for sample connection. Entered by F. E. Bradley, C. C. M. O. Company.

*36. Leech to drain liquid from vacuum lines. A container into which liquid from a vacuum gas gathering gravitates, a full-float-actuated double-seated valve vents container to atmosphere allowing liquid to gravitate out. Entered by Burton Hufford, Standard Oil Company of California.

37. Adjustable air pilot for pressure control of regulators. A pilot control adaptable to any bourdon type pressure gauge; does not interfere with operation of gauge. Entered by C. V. Baxter, Standard Oil Company of California.

38. Pump piston knock-off to remove pistons from pump rods without removing the rod from pump. Used similar to knock-off for automobile wheels. Knock-off is screwed on to piston rod; a few taps with hammer on end of rod loosens the piston. Entered by C. A. Davis, The Texas Company.

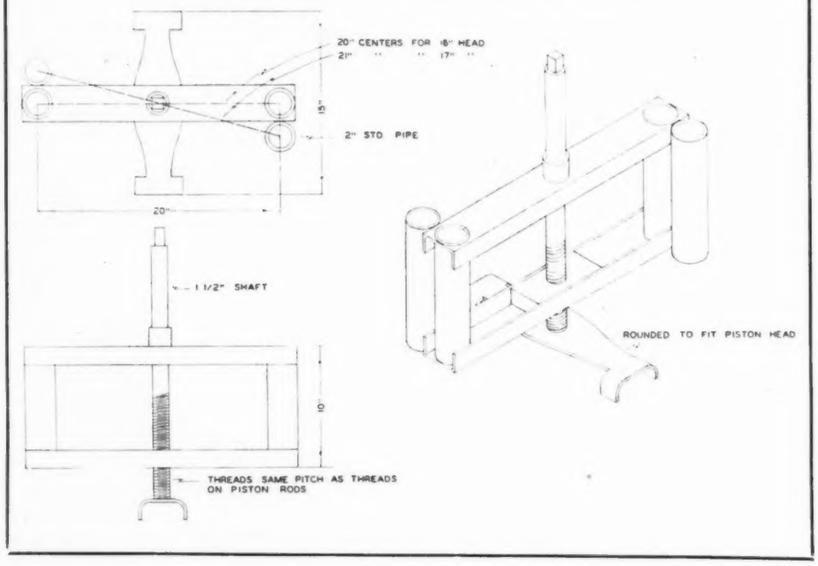
39. Automatic light switch to turn off lights in blacked-out building when door is opened. When door is opened the balance of a mercury switch is disturbed and circuit to light is broken; when door is shut the reverse action takes place. Entered by Fred Moore, The Texas Company.

40. Clark piston puller for installing and removing pistons from crosshead in Clark compressor engines. After cylinder head is removed the puller slides over cylinder bolts and is bolted in place. The spider engages the piston base. By rotating the stem the piston can be screwed in or out. Entered by Earl Levings, Lomita Gasoline Company.

*41. Pit repair plug inserter to screw pit plugs into line under pressure. Clamp on pipe holds ratchet wrench, holding pit plug in place over leak so that pressure can be applied to wrench as pit plug is screwed in place. Entered by L. R. McMaster, Standard Oil Company of California.

42. Instrument tool kit to facilitate mechanical repair and adjustment work on instruments and orifice meters. Kit provides space for all essential tools and supplies, and serves as a small work bench when hung in place on meter support. Entered by Melroy Welch, Barnsdall Oil Company.

Details of this piston puller are evident from the drawing



THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 61

THIS installment of the Continuous Tables marks the beginning of the sixth year since this section was adopted as a valuable and regular feature of *The Petroleum Engineer.* Throughout the last five years the original objective of the tables, to save time and effort for the technician and the practical field or plant worker, has been strictly adhered to. As a result, their reception has been such as to lead the editors to believe that they are accomplishing their original objective. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer.*

The tables in the last 60 installments, 370 tables, have presented material that consisted of tabular data rather than graphs, curves, alignment charts, or other methods of presenting relationships between two or more variables. A part of the original objective was the presentation of the data in the simplest form available—tabular form data are believed the most accurate and readily followed by the average reader than any other method available. There are many types of information best presented by curves or nomographs when three or more variables must be considered simultaneously. Such data as must be presented in the form of charts and graphs will later be included in the tables.

Readers throughout the industry have indicated their interest in the source of so many tables. All the tables have developed as a result of suggestions for new tables, direct contributions, and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

To readers of *The Petroleum Engineer,* who are only now becoming interested in the Continuous Tables, it should be pointed out that each table is assigned a filing or index number that conforms with the Dewey Decimal System of classification as modified and extended for the petroleum and related industries by L. C. Uren, professor of Petroleum Engineering at the University of California. This complete index has been published in earlier installments of the tables and is now available in booklet form at a cost of 50 cents per copy from *The Petroleum Engineer,* P. O. Box 1589, Dallas, Texas. Complete sets of the tables from the first installment to the present are also available in conjunction with subscriptions.

Of the 60 installments of the Continuous Tables published to date, the number of tables in each division and their general field classification number follow:

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Nos. P500-P599—Production	79
Nos. P600-P699—Transportation and storage (includes pipe line)	89
Nos. P700-P799—Refining, including	
Nos. P770-P799—Natural Gasoline, which may be classified in a separate division as shown here if of special interest to the user	46
Total	370

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Pipe line coefficients for gas flow—values of $d^{2.5}$	(sheet 5) P 622.001.	73	July
Pressure extensions—orifice meter calculations	(sheet 18) P 683.32	71	July

*This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941 issue, and 48-60, inclusive in the June, 1942, issue.

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Hyatt Bearings Division, General Motors Sales Corporation (sheet 5)	74	July	P 622.001.
Vortox Manufacturing Company (sheet 18)	72	July	P 683.32

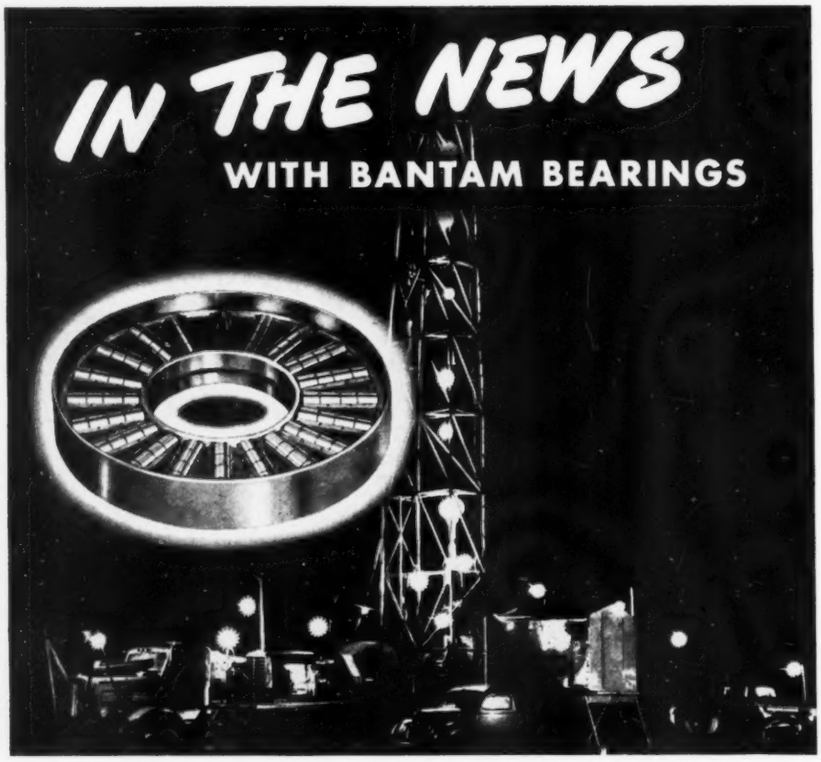
PIPE LINE COEFFICIENTS FOR GAS FLOW—VALUES OF $d^{2.5}$

Nominal size, in.	Wall Thickness, in.	Lb. per ft. plain ends	Inside diameter, d, in.	$d^{2.5}$
Steel pipe				
16	0.180		15.640	967.3682
	0.185		15.630	965.8230
	0.1875		15.625	965.0504
	0.189		15.622	964.5871
	0.194		15.612	963.0444
	0.203		15.594	960.2710
	0.21875		15.5625	955.4291
	0.222		15.556	954.4316
	0.234	39.40	15.532	950.7548
	0.238	40.06	15.524	949.5307
	0.250	42.05	15.500	945.8652
	0.259	43.54	15.482	943.1217
	0.270	45.35	15.460	939.7748
	0.28125	47.21	15.4375	936.3602
	0.284	47.66	15.432	935.5252
	0.300	50.30	15.400	930.6830
	0.302	50.63	15.396	930.0790
	0.3125	52.35	15.375	926.9104
	0.330	55.22	15.340	921.6447
	0.340	56.86	15.320	918.6434
	0.34375	57.47	15.3125	917.5196
A.P.I. 16 in.	0.375	62.58	15.250	908.1864
	0.401	66.80	15.199	900.6115
	0.40625	67.65	15.1875	898.9241
	0.4375	72.71	15.125	889.6896
	0.46875	77.75	15.0625	886.6310
	0.495	81.96	15.010	872.8745
	0.500	82.77	15.000	871.4216
	0.5625	92.74	14.875	853.3800
A.P.I. 17 in.	0.393	69.70	16.214	1,058.5222
18	0.21875		17.5625	1,292.6054
	0.222		17.556	1,291.4095
	0.234		17.532	1,287.0009
	0.238		17.524	1,285.5322
	0.245	46.45	17.510	1,282.9663
	0.250	47.39	17.500	1,281.1354
	0.259	49.07	17.482	1,277.8144
	0.28125	53.22	17.4375	1,269.7275
	0.284	53.73	17.432	1,268.7265
	0.300	56.71	17.400	1,262.9116
	0.310	58.56	17.380	1,259.2864
	0.3125	59.03	17.375	1,258.3806
	0.340	64.12	17.320	1,248.4461
	0.34375	64.82	17.3125	1,247.0948
	0.375	70.58	17.250	1,235.8701
	0.40625	76.33	17.1875	1,224.7059
A.P.I. 18 in.	0.409	76.84	17.182	1,223.5479
	0.4375	82.06	17.125	1,213.6025
	0.46875	87.76	17.0625	1,195.6575
	0.500	93.45	17.000	1,191.5775
	0.5625	104.75	16.875	1,172.4908
20	0.21875		19.5625	1,692.6261
	0.222		19.556	1,691.2191
	0.234		19.532	1,686.0358
	0.238		19.524	1,684.1926
	0.245		19.510	1,681.2926
	0.250		19.500	1,679.1384
	0.259		19.482	1,675.2660
	0.272	57.30	19.456	1,669.6831
	0.28125	59.23	19.4375	1,665.7161
	0.284	59.80	19.432	1,664.5383
	0.300	63.11	19.400	1,657.6939
	0.3125	65.70	19.375	1,652.3586
	0.340	71.39	19.320	1,640.6570
	0.34375	72.16	19.3125	1,639.0653
	0.375	78.59	19.250	1,625.8363
A.P.I. 20 in.	0.409	85.58	19.182	1,611.5167
	0.4375	91.40	19.125	1,599.5710
	0.46875	97.77	19.0625	1,586.5355
	0.500	104.13	19.000	1,573.5626
	0.5625	116.77	18.875	1,547.8096
22	0.21875		21.5625	2,158.9761
	0.222		21.556	2,157.3495
	0.234		21.532	2,151.3495
	0.238		21.524	2,149.3520
	0.245		21.510	2,145.8581
	0.250		21.500	2,143.3658
	0.259		21.482	2,138.8818
	0.272		21.456	2,132.4163
	0.28125		21.4375	2,127.8230
	0.284		21.432	2,126.4578
	0.301	69.75	21.398	2,118.0341
	0.3125	72.38	21.375	2,112.3471
	0.340	78.65	21.320	2,098.7850
	0.34375	79.50	21.3125	2,096.9401
	0.375	86.60	21.250	2,081.6000
	0.400	92.27	21.200	2,069.3780
	0.40625	93.69	21.1875	2,054.4687
	0.4375	100.75	21.125	2,051.1236
	0.46875	107.79	21.0625	2,035.9860
	0.500	114.81	21.000	2,020.9163
	0.5625	128.78	20.875	1,990.9772
Steel pipe				
24	0.21875		23.5625	2,694.9671
	0.222		23.556	2,693.2081
	0.234		23.532	2,686.2537
	0.238		23.524	2,683.9722
	0.245		23.510	2,679.9796
	0.250		23.500	2,677.1321
	0.259		23.482	2,672.0080
	0.272		23.456	2,664.3331
	0.28125		23,4375	2,659.3671
	0.284		23.432	2,657.8074
	0.301		23.398	2,648.1756
	0.3125	79.05	23.375	2,641.6726
	0.330	83.42	23.340	2,631.7964
	0.340	85.91	23.320	2,626.1606
	0.34375	86.84	23.3125	2,625.5621
	0.375	94.61	23.250	2,606.4988
	0.40625	102.36	23.1875	2,589.0174
	0.4375	110.09	23.125	2,571.6053
	0.46875	117.80	23.0625	2,554.2651
	0.500	125.49	23.000	2,536.9942
	0.5625	140.80	22.875	2,502.6655
26	0.21875		25.5625	3,303.7588
	0.222		25.556	3,301.6595
	0.234		25.532	3,293.9121
	0.238		25.524	3,291.3326
	0.245		25.510	3,286.9227
	0.250		25.500	3,283.6023
	0.259		25.482	3,277.8100
	0.272		25.456	3,269.4561
	0.28125		25.4375	3,263.5203
	0.284		25.432	3,261.7549
	0.301		25.398	3,250.8639
	0.3125	93.00	25.375	3,243.5104
	0.330	97.76	25.340	3,232.3358
	0.340	100.48	25.320	3,225.9622
	0.34375	101.50	25.3125	3,223.5754
	0.375	110.00	25.250	3,203.7125
	0.40625	118.50	25.1875	3,183.9250
	0.4375	127.00	25.1250	3,164.2101
	0.46875	135.50	25.0625	3,126.5187
	0.500	143.00	25.0000	3,125.0000
	0.5625	160.00	24.875	3,086.0844
	0.625	177.00	24.750	3,047.4586
	0.750	210.00	24.500	2,971.0863
28	0.21875		27.5625	3,988.3800
	0.222		27.556	3,986.0300
	0.234		27.532	3,977.3560
	0.238		27.524	3,974.4660
	0.245		27.510	3,969.4147
	0.250		27.500	3,965.8091
	0.259		27.482	3,959.3218
	0.272		27.456	3,949.9655
	0.28125		27.4375	3,943.3155
	0.284		27.432	3,941.3391
	0.301		27.398	3,929.1388
	0.3125	101.00	27.375	3,920.8959
	0.330	106.04	27.340	3,908.3757
	0.340	108.92	27.320	3,901.2321
	0.34375	110.00	27.3125	3,898.5562
	0.375	119.00	27.250	3,876.2902
	0.40625	128.00	27.1875	3,854.1026
	0.4375	138.00	27.125	3,831.9893
	0.46875	147.00	27.0625	3,809.9543
	0.500	156.00	27.000	3,787.9956
	0.5625	174.00	26.875	3,744.3060
	0.625	192.00	26.750	3,700.9179
	0.750	228.00	26.500	3,615.0542
30	0.21875		29.5625	4,751.7435
	0.222		29.556	4,749.1326
	0.234		29.532	4,739.4978
	0.238		29.524	4,736.2870
	0.245		29.510	4,730.6739
	0.250		29.500	4,726.6670
	0.259		29.482	4,719.4600
	0.272		29.456	4,709.0630
	0.28125		29.4375	4,701.6717
	0.284		29.432	4,699.4763
	0.301		29.398	4,685.9161
	0.3125	108.00	29.375	4,676.7570
	0.330	113.60	29.340	4,662.8376
	0.340	116.80	29.320	4,654.8957
30	0.34375	118.000	29.3125	4,651.9205
	0.375	128.000	29.250	4,627.1628
	0.40625	138.000	29.1875	4,602.4840
	0.4375	148.000	29.125	4,577.8790
	0.46875	158.000	29.0625	4,553.3653
	0.500	167.000	29.000	4,528.9240
	0.5625	187.000	28.875	4,480.2784
	0.625	206.000	28.750	4,431.9460
	0.750	245.000	28.500	4,336.2300

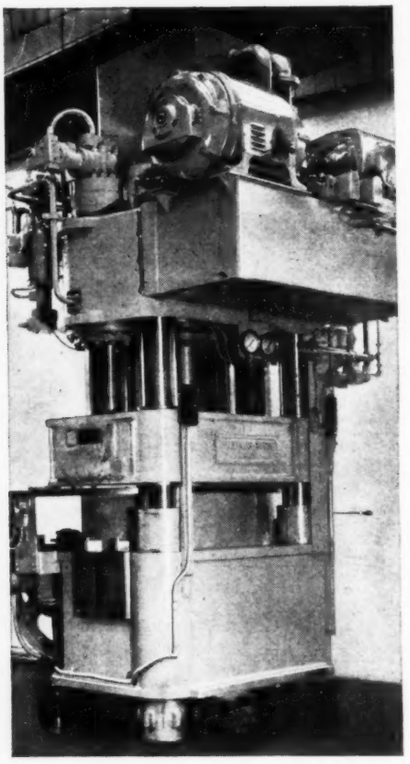
This group of tables was prepared by P. McDonald Biddison in connection with the article, "Computing Gas Flow in Pipe Lines," published in the August, September, and October, 1941, issues of *The Petroleum Engineer*.

As the general equation for the flow of gas in long lines involves a knowledge of the exact value of the internal diameter of the pipe, d, raised to the 2.5 power, these tables should facilitate flow calculations.

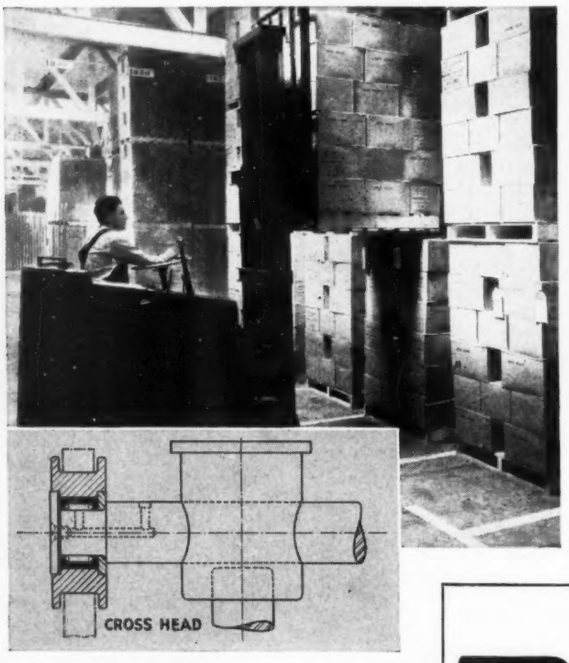
See sheet 5, column 2, of this series (P 622.001.) for similar data on cast iron pipe.



OIL IS AMMUNITION—and in the search for new sources of this essential war material modern drilling equipment is playing a vitally important role. Typical example of progressive design is this portable drilling unit built by Franks Manufacturing Corporation for quick location-to-location moves. Drawworks, pumps, auxiliary engines, and rotary drive equipment are mounted on a single truck—and derrick can be folded down by special patented screw mechanism. Main thrust bearing on swivel of this and similar Franks units is Bantam Flat Segmented Roller; main bearing and upper radial bearing in rotary table are Bantam Tapered Roller.



AIRCRAFT PARTS are formed in this 1200-ton three-column press made by Williams, White & Co. It is powered by an Oilgear Two Way Variable Displacement Pump equipped with two type ALI Bantam Radial Roller bearings on front and rear of rotor to insure efficient, dependable operation at all times.



MAN-HOURS SAVED in handling materials help keep production at peak levels. Lift trucks built by MacDonald Truck and Manufacturing Co. are designed throughout for safety, smoothness, and speed—and MacDonald selected Bantam Quill Bearings for use on cross-head (shown in cross-section drawing) and on tilt arms of these trucks.

BATTERIES OF THESE POWER-SQUARING SHEARS are being used in war production plants for squaring and trimming metal sheets and for producing narrow strips. Among the many progressive engineering features included by Niagara Machine & Tool Works is the use of Bantam Quill Bearings on the main shaft. For further information on these compact, high-capacity anti-friction bearings, write for Bulletin P-104.

BANTAM BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA

Static Press.
1700-1795 lb.

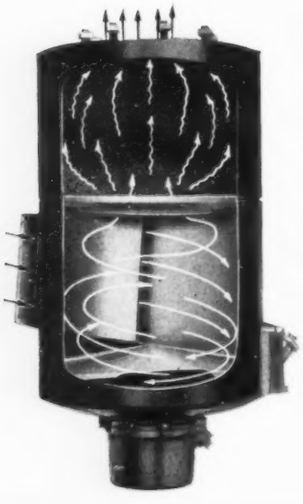
PRESSURE EXTENSIONS—ORIFICE METER CALCULATIONS

Differential pressure, in. of water	Static pressure, lb. per sq. in., ga.																			
	1700	1705	1710	1715	1720	1725	1730	1735	1740	1745	1750	1755	1760	1765	1770	1775	1780	1785	1790	1795
2	58.55	58.64	58.72	58.82	58.91	59.01	59.08	59.15	59.23	59.32	59.40	59.49	59.57	59.66	59.74	59.83	59.91	59.99	60.08	60.16
4	82.82	82.94	83.06	83.20	83.32	83.46	83.56	83.66	83.78	83.90	84.02	84.14	84.26	84.38	84.50	84.62	84.74	84.86	84.98	85.10
6	101.4	101.6	101.7	101.9	102.0	102.2	102.3	102.4	102.6	102.7	102.9	103.0	103.2	103.3	103.5	103.6	103.8	103.9	104.1	104.2
8	117.1	117.3	117.4	117.6	117.8	118.0	118.2	118.3	118.5	118.6	118.8	118.9	119.1	119.3	119.5	119.6	119.8	119.9	120.2	120.3
10	130.9	131.1	131.3	131.5	131.7	131.9	132.1	132.3	132.5	132.6	132.8	133.0	133.2	133.4	133.6	133.8	133.9	134.2	134.4	134.5
12	143.4	143.7	143.8	144.1	144.3	144.5	144.7	144.9	145.1	145.3	145.5	145.7	145.9	146.1	146.4	146.6	146.7	146.9	147.2	147.4
14	154.9	155.2	155.4	155.7	155.9	156.2	156.3	156.5	156.7	156.9	157.2	157.4	157.6	157.8	158.1	158.3	158.5	158.8	159.9	159.2
16	165.6	165.9	166.1	166.4	166.6	166.9	167.1	167.3	167.6	167.8	168.0	168.3	168.5	168.8	169.0	169.2	169.5	169.7	169.9	170.2
18	175.7	175.9	176.2	176.5	176.7	177.1	177.3	177.5	177.7	177.9	178.2	178.5	178.7	179.0	179.3	179.5	179.8	180.0	180.3	180.5
20	185.2	185.5	185.7	186.0	186.3	186.6	186.8	187.1	187.3	187.6	187.8	188.1	188.4	188.7	188.9	189.2	189.5	189.7	190.0	190.3
21	189.8	190.0	190.3	190.7	190.9	191.2	191.5	191.7	191.9	192.2	192.5	192.8	193.1	193.4	193.6	193.9	194.2	194.4	194.7	195.0
22	194.2	194.5	194.8	195.1	195.4	195.7	195.9	196.2	196.5	196.7	197.0	197.3	197.6	197.8	198.2	198.4	198.7	198.9	199.3	199.6
23	198.6	198.9	199.2	199.5	199.8	200.1	200.4	200.6	200.9	201.2	201.5	201.8	202.1	202.3	202.6	202.9	203.2	203.5	203.8	204.1
24	202.9	203.2	203.5	203.8	204.1	204.4	204.7	204.9	205.2	205.5	205.8	206.1	206.4	206.7	206.9	207.3	207.6	207.9	208.2	208.5
25	207.1	207.4	207.7	208.0	208.3	208.7	208.9	209.2	209.5	209.8	210.1	210.4	210.7	210.9	211.3	211.6	211.9	212.2	212.5	212.7
26	211.1	211.5	211.8	212.1	212.4	212.8	213.0	213.3	213.6	213.9	214.2	214.5	214.8	215.1	215.4	215.7	216.0	216.4	216.6	216.9
27	215.2	215.5	215.8	216.2	216.5	216.8	217.1	217.3	217.7	217.9	218.3	218.6	218.9	219.2	219.5	219.8	220.2	220.5	220.8	221.1
28	219.1	219.5	219.8	220.2	220.5	220.8	221.1	221.4	221.7	221.9	222.3	222.6	222.9	223.3	223.6	223.9	224.2	224.5	224.8	225.2
29	222.9	223.3	223.6	224.0	224.3	224.7	224.9	225.3	225.6	225.9	226.2	226.5	226.9	227.2	227.5	227.8	228.2	228.5	228.8	229.1
30	226.8	227.1	227.5	227.8	228.2	228.6	228.8	229.1	229.4	229.7	230.1	230.4	230.7	231.1	231.4	231.7	232.1	232.4	232.7	233.0
31	230.1	230.9	231.2	231.6	231.9	232.3	232.6	232.9	233.2	233.6	233.9	234.2	234.6	234.9	235.2	235.6	235.9	236.3	236.6	236.9
32	234.3	234.6	234.9	235.3	235.7	236.1	236.3	236.6	236.9	237.3	237.6	237.9	238.3	238.7	239.0	239.3	239.7	240.0	240.4	240.7
33	237.9	238.2	238.6	238.9	239.3	239.7	240.0	240.3	240.6	241.0	241.3	241.7	242.0	242.4	242.7	243.1	243.4	243.8	244.1	244.4
34	241.5	241.8	242.2	242.6	242.9	243.3	243.6	243.9	244.3	244.6	244.9	245.3	245.7	246.0	246.3	246.7	247.1	247.4	247.7	248.1
35	244.9	245.3	245.7	246.1	246.5	246.8	247.2	247.5	247.8	248.2	248.5	248.9	249.2	249.6	249.9	250.3	250.7	251.0	251.4	251.7
36	248.5	248.8	249.2	249.6	249.9	250.4	250.7	250.9	251.3	251.7	252.1	252.4	252.8	253.1	253.5	253.9	254.2	254.6	254.9	255.3
37	251.9	252.3	252.6	253.1	253.4	253.8	254.1	254.4	254.8	255.2	255.5	255.9	256.3	256.6	257.0	257.4	257.7	258.1	258.5	258.8
38	255.3	255.6	255.9	256.4	256.8	257.2	257.5	257.8	258.2	258.6	258.9	259.3	259.7	260.0	260.4	260.8	261.2	261.5	261.9	262.3
39	258.6	258.9	259.4	259.8	260.2	260.6	260.9	261.2	261.6	261.9	262.4	262.7	263.1	263.5	263.8	264.2	264.6	264.9	265.4	265.7
40	261.9	262.3	262.7	263.1	263.5	263.9	264.3	264.6	264.9	265.3	265.7	266.1	266.5	266.8	267.2	267.6	267.9	268.4	268.7	269.1
41	265.1	265.5	265.9	266.4	266.7	267.2	267.5	267.8	268.2	268.6	268.9	269.4	269.8	270.1	270.5	270.9	271.3	271.7	272.1	272.4
42	268.4	268.7	269.2	269.6	269.9	270.4	270.8	271.1	271.5	271.9	272.3	272.7	273.0	273.4	273.8	274.2	274.6	274.9	275.4	275.8
43	271.5	271.9	272.3	272.8	273.2	273.6	273.9	274.3	274.7	275.7	275.5	275.8	276.2	276.6	277.0	277.4	277.8	278.2	278.6	279.0
44	274.7	275.1	275.5	275.9	276.3	276.8	277.1	277.5	277.8	278.3	278.6	279.1	279.4	279.8	280.2	280.6	281.0	281.4	281.8	282.2
45	277.8	278.2	278.6	279.1	279.5	279.9	280.3	280.6	280.9	281.4	282.8	282.2	282.6	283.0	283.4	283.8	284.2	284.6	285.0	285.4
46	280.8	281.2	281.7	282.1	282.5	283.0	283.4	283.7	284.1	284.5	284.9	285.3	285.7	286.1	286.5	286.9	287.4	287.8	288.2	288.6
47	283.9	284.3	284.7	285.2	285.6	286.1	286.4	286.8	287.2	287.6	288.0	288.4	288.8	289.3	289.7	290.1	290.5	290.9	291.3	291.7
48	286.9	287.3	287.7	288.2	288.6	289.1	289.5	289.8	290.2	290.6	291.0	291.5	291.9	292.3	292.7	293.1	293.5	293.9	294.4	294.8
49	289.9	290.3	290.7	291.2	291.6	292.1	292.5	292.8	293.2	293.6	294.1	294.5	294.9	295.3	295.7	296.2	296.6	297.0	297.4	297.9
50	292.8	293.2	293.7	294.2	294.6	295.2	295.4	295.8	296.2	296.6	297.1	297.5	297.9	298.3	298.7	299.2	299.6	300.0	300.4	300.9
51	295.7	296.1	296.6	297.1	297.5	297.9	298.4	298.7	299.1	299.6	299.9	300.4	300.8	301.3	301.7	302.1	302.6	302.9	303.4	303.8
52	298.6	299.0	299.5	299.9	300.4	300.9	301.3	301.6	302.1	302.5	302.9	303.4	303.8	304.2	304.7	305.1	305.5	305.9	306.4	306.8
53	301.5	301.9	302.3	302.8	303.3	303.8	304.2	304.5	304.9	305.4	305.8	306.3	306.7	307.1	307.6	308.0	308.5	308.9	309.3	309.8
54	304.3	304.7	305.2	305.6	306.1	306.6	306.9	307.4	307.8	308.2	308.7	309.1	309.6	310.0	310.4	310.9	311.3	311.8	312.2	312.6
55	307.1	307.5	307.9	308.5	308.9	309.5	309.8	310.2	310.6	311.1	311.5	311.9	312.4	312.9	313.3	313.8	314.2	314.7	315.1	315.6
56	309.8	310.3	310.8	311.3	311.7	312.3	312.6	313.0	313.5	313.9	314.4	314.8	315.3	315.7	316.2	316.6	317.1	317.5	317.9	318.4
57	312.6	313.1	313.6	314.1	314.5	315.1	315.4	315.8	316.3	316.7	317.2	317.6	318.1	318.5	318.9	319.4	319.8	320.3	320.8	321.3
58	315.4	315.8	316.3	316.8	317.3	317.8	318.2	318.6	319.0	319.5	319.9	320.4	320.9	321.3	321.8	322.2	322.7	323.1	323.6	324.1
59	318.1	318.5	318.9	319.5	319.9	320.5	320.9	321.3	321.8	322.2	322.7	323.1	323.6	324.1	324.5	324.9	325.4	325.9	326.4	326.8
60	320.8	321.2	321.7	322.2	322.7	323.2	323.6	324.0	324.5	324.9	325.4	325.9	326.3	326.8	327.3	327.7	328.2	328.7	329.1	329.6
61	323.4	323.9	324.3	324.9	325.4	325.9	326.3	326.7	327.2	327.6	328.1	328.6	329.0	329.5	329.9	330.4	330.9	331.4	331.8	332.3
62	326.1	326.5	327.0	327.6	328.0	328.6	328.9	329.4	329.8	330.3	330.8	331.3	331.7	332.2	332.7	333.1	333.6	334.1	334.6	335.0
63	328.7	329.1	329.6	330.2	330.6	331.2	331.6	332.0	332.5	332.9	333.4	333.9	334.4	334.9	335.3	335.8	336.3	336.7	337.2	337.7
64	331.3	331.7	332.2	332.8	333.8	333.8	334.2	334.6	335.1	335.6	336.1	336.6	337.0	337.5	338.0	338.5	338.9	339.4	339.9	340.4
65	333.8	334.3	334.8	335.4	335.8	336.4	336.8	337.2	337.7	338.2	338.7	339.2	339.7	340.1	340.6	341.1	341.6	342.1	342.6	343.0
66	336.4	336.9	337.4	337.9	338.4	339.0	339.4	339.8	340.3	340.8	341.3	341.8	342.3	342.8	343.2	343.7	344.2	344.7	345.2	345.7
67	338.9	339.4	339.9	340.5	340.9	341.6	341.9	342.4	342.9	343.4	343.8	344.3	344.8	345.3	345.8	346.3	346.8	347.3	347.8	348.3
68	341.5	341.9	342.5	343.0	343.5	344.1	344.5	344.9	345.4	345.9	346.4	346.9	347.4	347.9	348.4	348.9	349.4	349.9	350.4	350.9
69	343.9	344.4	344.9	345.6	346.1	346.6	347.1	347.5	347.9	348.5	348.9	349.5	349.9	350.5	350.9	351.5	351.9	352.5	352.9	353.5
70	346.5	346.9	347.5	348.1	348.6	349.2	349.6	349.9	350.5	350.9	351.5	351.9	352.5	353.0	353.5	354.0	354.5	355.0	355.5	356.0
71	348.9	349.4	349.9	350.5	351.0	351.6	352.0	352.5	352.9	353.5	353.9	354.5	354.9	355.5	355.9	356.5	357.0	357.5	358.0	358.5
72	351.4	351.9	352.4	352.9	353.5	354.1	354.5	354.9	355.4	355.9	356.4	356.9	357.5	357.9	358.5	359.0	359.5	360.0	360.5	361.0
73	353.8	354.3	354.8	355.4	355.9	356.5	356.9	357.4	357.9	358.4	358.9	359.4	359.9	360.5	360.9	361.5	362.0	362.5	363.0	363.5
74	356.2	356.7	357.2	357.8	358.4	358.9	359.4	359.8	360.3	360.8	361.4	361.9	362.4	362.9	363.4	363.9	364.5	364.9	365.5	366.0
75	358.6	359.1	359.6	360.3	360.8	361.4	361.8	362.2	362.8	363.3	363.8	364.3	364.8	365.4	365.9	366.4	366.9	367.4	367.9	368.5
76	361.0	361.5	362.1	362.7	362.2	363.8	364.2	364.7	365.2	365.7	366.2	366.8	367.3	367.8	368.3	368.8	369.4	369.9	370.4	370.9
77	363.4	363.9	364.4	365.0	365.6	366.2	366.6	367.1	367.6	368.1	368.6	369.2	369.7	370.2	370.7	371.3	371.8	372.3	372.8	373.4
78	365.7	366.3	366.8	367.4	367.9	368.6	369.0	369.4	369.9	370.5	371.0	371.6	372.1	372.6	373.2	373.7	374.2	374.7	375.3	375.8
79	368.1	368.6	369.1	369.7	370.3	370.9	371.3	371.8	372.3	372.8	373.4	373.9	374.5	374.9	375.5	376.1	376.6	377.1	377.6	378.2
80	370.4	370.9	371.4	372.1	372.6	372.3	373.7	374.1	374.7	375.2	375.7	376.3	376.8	377.3	377.9	378.4	378.9	379.5	380.0	380.6
82	374.9	375.5	376.1	376.7	377.2	377.9	378.3	378.7	379.3	379.8	380.4	380.9	381.5	382.0	382.6	383.1	383.7	384.2	384.7	385.3
84	379.5	380.1	380.6	381.3	381.8	382.5	382.9	383.4	383.9	384.5	385.0	385.6	386.1	386.7	387.2	387.8	388.3	388.9	389.4	389.9
86	384.0	384.6	385.1	385.8	386.4	387.0	387.5	387.9	388.5	389.0	389.6	390.2	390.7	391.3	391.8	392.4	392.9	393.5	394.1	394.6
88	388.5	389.0	389.6	390.2	390.8	391.5	391.9	392.4	392.9	393.5	394.1	394.6	395.2	395.8	396.3	396.9	397.5	398.0	398.6	399.2
90	392.9	393.4	393.9	394.6	395.2	395.9	396.4	396.8	397.4	397.9	398.5	399.1	399.7	400.3	400.8	401.4	401.9	402.5	403.1	403.7
92	397.2	397.8	398.4	399.0	399.6	400.3	400.8	401.2	401.8	402.4	402.9	403.5	404.1	404.7	405.3	405.8	406.4	406.9	407.6	408.1
94	401.5	402.1	402.6	403.3	403.9	404.6	405.1	405.5	406.1	406.7	407.3	407.9	408.4	409.0	409.6	410.2	410.8	411.4	411.9	412.5
96	405.7	406.3	406.9	407.6	408.2	408.9	409.4	409.9	410.4	411.0	411.6	412.2	412.8	413.4	413.9	414.6	415.1	415.7	416.3	416.9
98	409.9	410.5	411.1	411.8	412.4	413.1	413.6	414.1	414.7	415.3	415.8	416.5	417.0	417.6	418.2	418.8	419.4	420.0	420.6	421.2
100	414.1	414.7	415.3	416.0	416.6	417.3	417.8	418.3	418.9	419.5	420.1	420.7	421.3	421.9	422.5	423.1	423.7	424.3	424.9	425.5

NOTE: Values given in body of table are products of the square roots of the static and differential pressures in lb. per sq. in., abs., and inches of water respectively.

Absolute pressures are based on atmospheric pressure of 15 lb. per sq. in.

Table has been condensed to serve field men in approximating meter readings, intermediate readings for accurate measurements may be obtained from pressure extension books, usually available in district offices.



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And because the filter element on the Vortox is kept constantly clean by the washing action of the oil, there are no dust-clogged filters to require frequent servicing, replacement or repair. All dust is trapped in the oil reservoir—*and a periodic oil change is the only maintenance needed to completely remove all dirt and prepare the Cleaner for another long run.*

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VORTOX MANUFACTURING COMPANY • CLAREMONT, CALIFORNIA

VORTOX

OIL TYPE SELF-WASHING AIR CLEANER

PIPE LINE COEFFICIENTS FOR GAS FLOW—VALUES OF $d^{2.5}$

Nominal size, in.	Wall Thickness, in.	Lb. per ft. plain ends	Inside diameter, d, in.	$d^{2.5}$
Steel pipe				
36	0.21875		35.5625	7,541.9000
	0.222		35.556	7,538.4544
	0.234		35.532	7,525.7414
	0.238		35.524	7,521.5053
	0.245		35.510	7,514.0966
	0.250		35.500	7,508.8086
	0.259		35.482	7,499.2931
	0.272		35.456	7,485.5603
	0.28125		35.4375	7,475.8000
	0.284		35.432	7,472.9000
	0.301		35.398	7,454.9862
	0.3125	133.000	35.375	7,442.8800
	0.330	139.720	35.340	7,424.4845
	0.340	143.560	35.320	7,413.9864
	0.34375	145.000	35.3125	7,410.0525
	0.375	157.000	35.250	7,377.3068
	0.40625	169.000	35.1875	7,344.6483
	0.4375	181.000	35.125	7,312.0780
	0.46875	193.000	35.0625	7,279.5966
	0.500	205.000	35.000	7,247.1966
	0.5625	229.000	34.875	7,182.6633
	0.625	253.000	34.750	7,118.4754
	0.750	299.000	34.500	6,991.1371
	0.875	348.000	34.250	6,865.1730
	1.000	580.000	33.000	6,255.8275
42	0.21875		41.5625	11,136.6436
	0.222		41.556	11,132.2846
	0.234		41.532	11,116.7289
	0.238		41.524	11,110.8692
	0.245		41.510	11,101.5031
	0.250		41.500	11,094.8210
	0.259		41.482	11,082.7959
	0.272		41.456	11,065.4351
	0.28125		41.4375	11,053.0967
	0.284		41.432	11,049.4275
	0.301		41.398	11,026.7741
	0.3125	149.000	41.375	11,011.4619
	0.330	156.840	41.340	10,988.1924
	0.340	161.320	41.320	10,974.8810
	0.34375	163.000	41.3125	10,969.9290
	0.375	177.000	41.250	10,928.4861
	0.40625	191.000	41.1875	10,887.1404
	0.4375	204.000	41.125	10,845.8800
	0.46875	218.000	41.0625	10,804.7190
	0.500	232.000	41.000	10,763.6561
	0.5625	260.000	40.875	10,681.8010
	0.625	287.000	40.750	10,600.3230
	0.750	342.000	40.500	10,438.4856
	0.875	398.000	40.250	10,301.8409
	1.000	451.000	40.000	10,119.2890
48	0.21875		47.5625	15,601.3369
	0.222		47.556	15,596.0000
	0.234		47.532	15,576.3369
	0.238		47.524	15,569.7814
	0.245		47.510	15,558.3118
	0.250		47.500	15,550.1290
	0.259		47.482	15,535.4014
	0.272		47.456	15,549.9068
	0.28125		47.4375	15,499.0286
	0.284		47.432	15,494.5322
	0.301		47.398	15,466.7829
	0.3125	172.000	47.375	15,448.0249
	0.330	180.960	47.340	15,419.5177
	0.340	186.080	47.320	15,403.2350
	0.34375	188.000	47.3125	15,397.1312
	0.375	204.000	47.250	15,346.3286
	0.40625	220.000	47.1875	15,295.6338
	0.4375	236.000	47.125	15,245.0386
	0.46875	252.000	47.0625	15,194.5385
	0.500	266.000	47.000	15,144.1463
	0.5625	298.000	46.875	15,043.6528
	0.625	330.000	46.750	14,944.5567
	0.750	394.000	46.500	14,744.5828
	0.875	458.000	46.250	14,547.2000
	1.000	520.000	46.000	14,351.4073

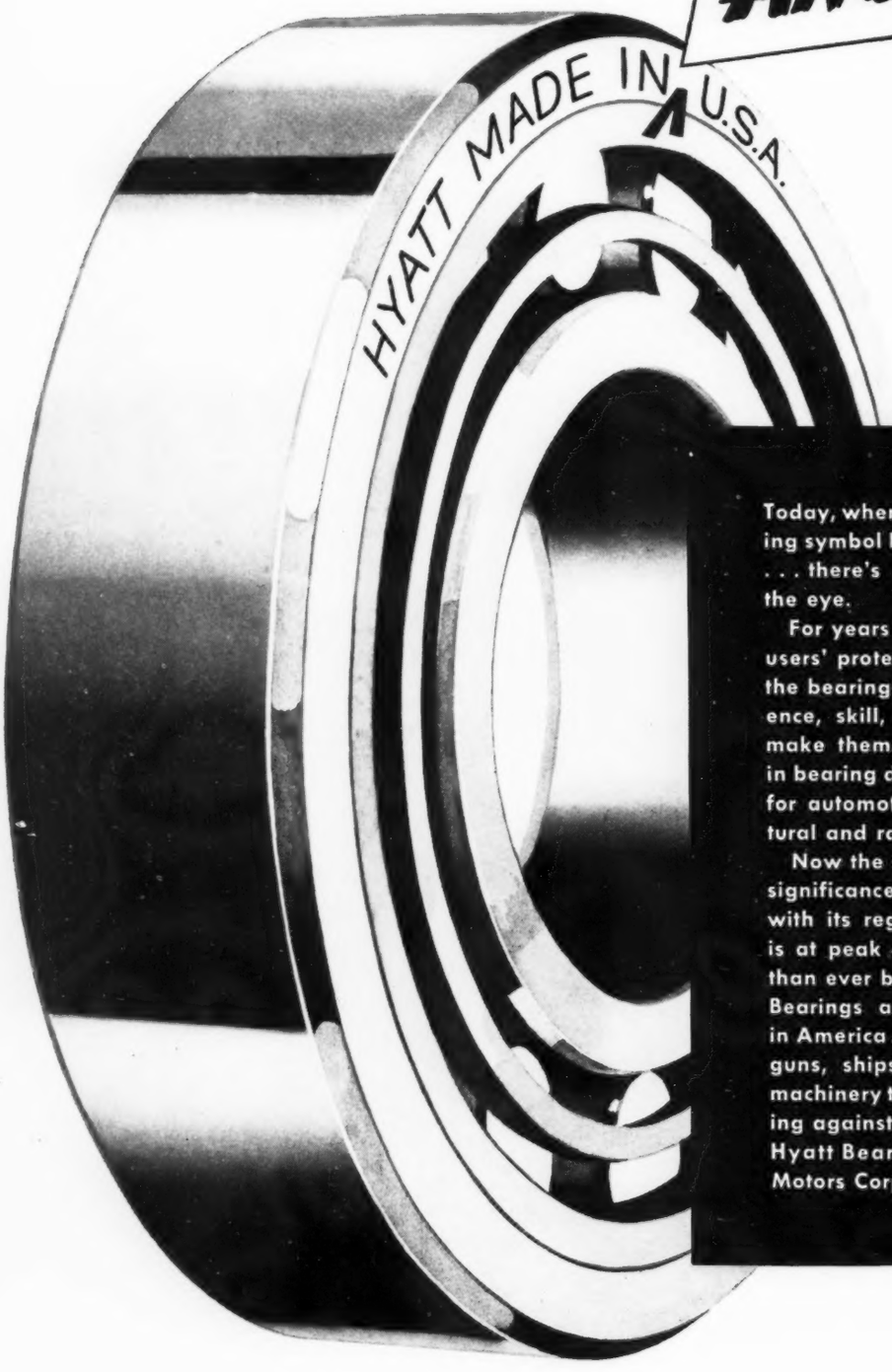
Nominal size	Thickness	Inside diameter	$d^{2.5}$
Cast iron pipe			
1¼ McWane	0.19	0.870	0.7060
1½ McWane	0.22	1.060	1.1561
2 McWane	0.25	1.500	2.7557
3 McWane	0.31	2.380	8.7386
3 S. DeLavaud	0.33	3.140	17.4713
3 S. DeLavaud	0.36	3.080	16.6486
A.W.A.	0.39	3.020	15.8496
A.W.A.	0.42	3.120	17.1944
A.W.A.	0.45	3.060	16.3796
A.W.A.	0.48	3.000	15.5885
4 S. DeLavaud	0.34	4.120	34.4543
S. DeLavaud	0.38	4.040	32.8060
A.G.A. *	0.40	4.000	32.0000
A.W.A. —A	0.42	3.960	31.2060
B	0.45	4.100	34.0377
C	0.48	4.040	32.8060
D	0.52	3.960	31.2060
6 S. DeLavaud	0.37	6.160	94.1785
S. DeLavaud*	0.43	6.040	89.6587
A.W.A. —A	0.44	6.020	88.9183
B	0.48	6.140	93.4159
C	0.51	6.080	91.1505
D	0.55	6.000	88.1817
8 S. DeLavaud	0.42	8.210	193.1337
S. DeLavaud	0.46	8.130	188.4631
S. DeLavaud	0.50	8.050	183.8611
A.G.A. *	0.45	8.150	189.6243
A.W.A. —A	0.46	8.130	188.4631
B	0.51	8.030	182.7211
C	0.56	8.180	191.3741
D	0.60	8.100	186.7293
10 S. DeLavaud	0.47	10.16	329.0291
S. DeLavaud	0.52	10.06	320.9926
S. DeLavaud	0.57	0.996	313.0750
A.G.A. *	0.49	10.12	325.8002
A.W.A. —A	0.50	10.10	324.1929
B	0.57	9.96	313.0750
C	0.62	10.16	329.0291
D	0.68	10.04	319.3996
12 S. DeLavaud	0.50	12.20	519.8757
S. DeLavaud	0.57	12.06	505.0894
S. DeLavaud	0.62	11.96	494.6841
A.W.A. A*	0.54	12.12	511.3951
B	0.62	11.96	494.6841
C	0.68	12.14	513.5075
D	0.75	12.00	498.8305
14 S. DeLavaud	0.48	14.34	778.7050
S. DeLavaud	0.55	14.20	758.9633
S. DeLavaud	0.62	14.06	741.2476
A.W.A. —A	0.57	14.16	754.4984
B	0.66	13.98	730.7486
C	0.74	14.17	755.8312
D	0.82	14.01	734.6751
16 S. DeLavaud	0.52	16.36	1,082.5758
S. DeLavaud	0.60	16.20	1,056.3005
S. DeLavaud	0.68	16.04	1,030.4121
A.W.A. —A	0.60	16.20	1,056.3005
B	0.70	16.00	1,030.4121
C	0.80	16.20	1,056.3005
D	0.89	16.02	1,027.2031
A.G.A. *	0.62	16.08	1,036.8477
18 S. DeLavaud	0.56	18.38	1,448.3143
S. DeLavaud	0.65	18.20	1,413.1182
S. DeLavaud	0.74	18.02	1,378.4371
A.W.A. —A	0.64	18.22	1,417.0036
B	0.75	18.00	1,374.6158
C	0.87	18.18	1,409.2395
D	0.96	18.00	1,374.6158
20 S. DeLavaud	0.58	20.44	1,888.9709
S. DeLavaud*	0.68	20.24	1,843.0042
S. DeLavaud	0.78	20.04	1,797.8120
A.W.A. —A	0.67	20.26	1,847.5600
B	0.80	20.00	1,788.8543
C	0.92	20.22	1,838.4551
D	1.03	20.00	1,788.8543
24 S. DeLavaud	0.64	24.52	2,977.1541
S. DeLavaud	0.76	24.28	2,904.8360
S. DeLavaud	0.88	24.04	2,833.5856
A.W.A. —A*	0.76	24.28	2,904.8360
B	0.89	24.02	2,827.6948
C	1.04	24.24	2,892.8873
D	1.16	24.00	2,821.8117
30 A.W.A. —A	0.88	29.98	4,921.2909
B	1.03	29.94	4,904.8921
C	1.20	30.00	4,929.5045
D	1.37	30.00	4,929.5045
A.G.A. *	0.85	30.04	4,945.9511
36 A.W.A. —A	0.99	35.18	7,340.7340
A.G.A. *	0.95	36.06	7,808.4400
42 A.W.A. —A	1.10	42.00	11,432.0289
A.G.A. *	1.07	42.06	11,472.9024
48 A.W.A. —A*	1.26	47.98	15,945.9524
54 A.W.A. —A	1.35	53.96	21,388.4729
60 A.W.A. —A	1.39	60.02	27,908.7244

This group of tables was prepared by P. McDonald Biddison in connection with the article, "Computing Gas Flow in Pipe Lines," published in the August, September, and October, 1941, issues of *The Petroleum Engineer*.

As the general equation for the flow of gas in long lines involves a knowledge of the exact value of the internal diameter of the pipe, d, raised to the 2.5 power, these tables should facilitate flow calculations.

See sheet 5, column 2, of this series (P 622.001.) for similar data on cast iron pipe.

*Also A.G.A. Standard.



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THE 50TH YEAR OF

HYATT ROLLER BEARINGS

Prevention of Fires, Explosions, and Accidents from Inflammable Fluids

PART 2 (Concluded)

by G. M. Kintz

Supervising Engineer, District G, Health and Safety Branch, U. S. Bureau of Mines

Direction of Flame Propagation

In the demonstration presented, the direction of flame propagation has been confined to the horizontal and vertical. In each instance the flame traveled away from the source of ignition.

Propagation of flame[5] depends upon transfer of energy from burned to unburned gas. The amount of energy available for transfer in mixtures close to the upper or lower limits is so small that the flame has very little speed and develops little pressure. Thus, especially at these points, any cooling effect of the tube, the water droplets on the sides, size of tubes, shape of vessel, and other factors beyond the scope of this paper, will affect the inflammable limits of the gas, the flame speed, and pressures developed.

The effect of moisture on the sides of a small 2-in. glass tube upon speed of flame will be noted when the horizontal tube, which contains moisture condensed from previous explosions, is again filled with a rich mixture (a little over 7 percent butane-air). The flame travels even more slowly and in some demonstrations never reaches the end of the tube. This is not intended to show the effect of humidity on flame propagation, as many other factors are involved; it is intended to show that many conditions may change the speed of flame-travel pressures developed and also the inflammable limits.

Need of Proper Venting

It is well-known that unless a gas appliance is adjusted properly, carbon monoxide and other objectionable gases may be formed. When certain types of unvented space heaters are lighted in confined areas, an odor resembling that of formaldehyde is noted until the fire-clay or other parts become heated. The aldehydes may be formed during a period of incomplete combustion. The complete combustion of gas forms carbon dioxide and water; unless carried away by proper venting, the water makes the room atmosphere very humid and condenses on the windows and walls.

[5]Coward, H. F., Jones, G. W., Limits of Inflammability of Gases and Vapors, Bureau of Mines Bulletin 279, 1939, pp. 3, 4.

A photograph and biographical sketch of the author of this article can be found on page 77 of the June issue of *The Petroleum Engineer* in connection with Part 1.

The amount of moisture condensed in these tubes during the burning of a small volume of gas is an indication of the amount of water produced by burning gas. According to Gas Engineers Handbook (p. 100) 1 lb. of methane gas will generate 2.24 lb. of water.

One cubic foot of methane weighs 0.044+ lb.; thus, 22.7 cu. ft. of methane will generate approximately 2.24 lb. of water, or about 1 quart. This is approximately the amount produced by burning a 50,000-B.t.u. natural-gas appliance for 30 minutes.

Enough moisture may be generated to form icicles in cold areas of a building. The general public and many workers do not, as a whole, understand these basic facts. Thus, they make no effort to correct a simple condition that might lead to sickness or accidents that would delay defense work.

Ignition Temperature

Every electric spark will not ignite gas. This can be demonstrated by causing an arc to jump between two vertical wires sealed in a glass chamber containing an explosive methane-air atmosphere. With this special equipment using a low voltage, the first arc does not usually ignite the gas, but continued arcing caused by the swinging wires making contact does ignite the gas. The U. S. Bureau of Mines is preparing equipment to study electric arcs to determine why they do or do not ignite gases.

Another demonstration, developed by G. W. Jones, chemist, Explosives Division, U. S. Bureau of Mines, proves that certain mixtures of helium-oxygen and inflammable gases are not ignited by static or high-tension sparks, but they can be ignited by most flames. This information is proving valuable in making the administration of anesthetics safer from ignition by static or electric sparks. It also will be valuable

TABLE I

Ignition temperatures and limits of inflammability of gases and vapors*

Gas or vapor	Ignition temperature, °F.		Limits of inflammability, percent by volume	
	In air	In oxygen	In air	In oxygen
Hydrogen	1076-1094	1076-1094	4.1-74	4.0-94
Carbon monoxide	1191-1216	1155-1229	12.5-74	15.5-94
Methane	1193-1216	1033-1292	5.3-14	5.4-59
Methane (turbulent)			5.0-15	
Ethane	933-1101	968-1166	3.2-12.5	4.1-50
Propane	957-1090	914-1058	2.4- 9.5	
Butane (N)	912-1056		1.8- 8.4	
Butane (iso)		1013-1022	1.8- 8.4	
Pentane (N)	889-1018		1.4- 7.8	
Hexane (N)	487- 516	478	1.2- 6.9	
Heptane (N)	451- 484	455	1.0- 6.0	
Octane (N)	417	405	0.9	
Ethylene	1008-1017	932- 966	3.0-29	2.9-80
Propylene	856- 923	927- 952	2.0-11.1	2.1-53
Butylene	829- 898		1.7- 9.0	
Acetylene	581- 932	565- 734	2.5-80	2.8-93
Benzene	968	Above 955	1.4- 6.7	
Toluene	1026-1031	961	1.3- 6.7	
Methyl alcohol	885	932	6.7-36	
Ethyl alcohol	790- 849	743	3.3-19	
Ethyl ether	579	360	1.8-48	2.1-82
Acetone	1042	939	2.5-13	
Hydrogen sulphide	655- 714	428- 455	4.3-45.5	
Carbon disulphide	248- 313	225- 270	1.2-50	
Ammonia	1436	1292-1580	16-27	15-79
Cyanogen	1562-1584		6.6-43	
Water gas	.....	.....	.....	.....

*Compiled by G. W. Jones; the temperatures are those he considered at the time (July 11, 1939) to be most representative.

where there is danger of ignition from static or electric sparks of inflammable substances being handled in the presence of oxygen.

To ignite a gas and propagate flame, the temperature of the ignition source must be high enough long enough to make the gas layer surrounding the heat source "burst into flame" rapidly, with enough heat energy to raise the next layer to the ignition temperatures.

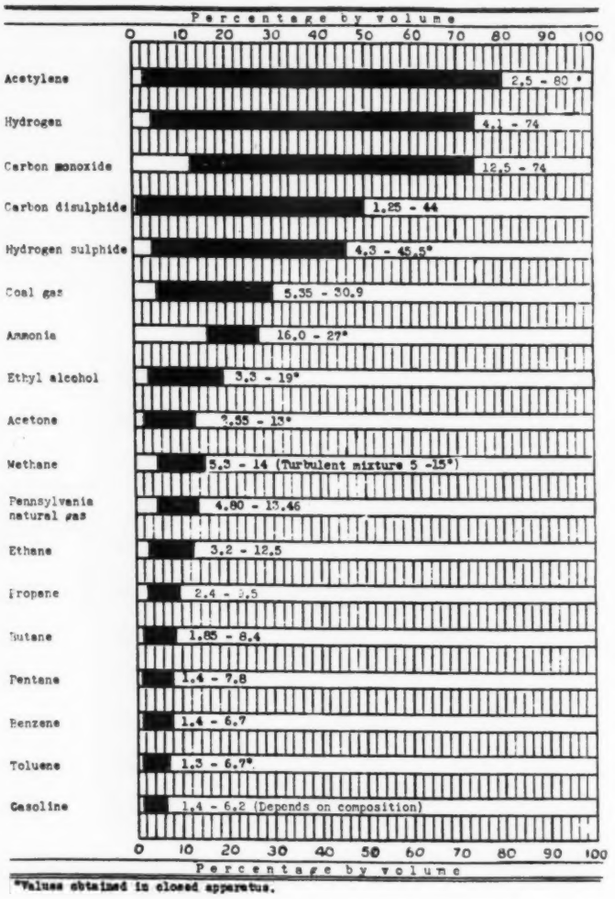
Table 1, which gives ignition temperatures and limits of inflammability of gases and vapors, was compiled by Jones, and the temperatures were believed by him (on July 11, 1939) to be the most representative. At present, he is making actual tests of certain gases in this table and has found that the low figure for acetylene should be 581 in air and 565 in oxygen.

The amount of heat that must be added to a gas to make it ignite naturally depends on the temperature of the gas. Thus, to ignite a methane-air mixture in a mine having a temperature of 65°F. would require more heat, at the same temperature, than a methane-air mixture in a meter house on an oil lease during a hot summer day. That it requires a certain temperature and intensity of heat to ignite the gas can be demonstrated by placing a heated filament in an explosive methane-air atmosphere and slowly raising the temperature of the filament. Ignition does not take place until a few moments after the filament reaches nearly white heat.

Approval of permissible hand lamps, incuding flashlights, is based upon this fact. The ordinary approved flashlight or hand light is not explosion-proof in the sense that all ignition sources are sealed in a case strong enough to withstand an explosion and prevent the emission of flame, but it will not ignite methane-air mixtures owing to switch construction, wattage and construction of the globe, and the manner in which globe or filament is connected to the source of power.

Generally, the globe is held in contact against a strong spring in such a way that the globe is ejected or the electrical contact broken if the glass of the globe is broken, exposing the heated filament. Although the filament may have sufficient heat intensity, the heat does not last long enough to ignite the inflammable mixture. This can be demonstrated readily by breaking two lighted bulbs, one secured in a socket as described above and the other as in a conventional-type hand lamp or flashlight in an explosive mixture. When the approved or permissible type is broken, the mixture does not ignite, but when the conventional type is broken an explosion occurs.

Fig. 4. Graphic representation of limits of inflammability of single gases and vapors



Ignition Sources

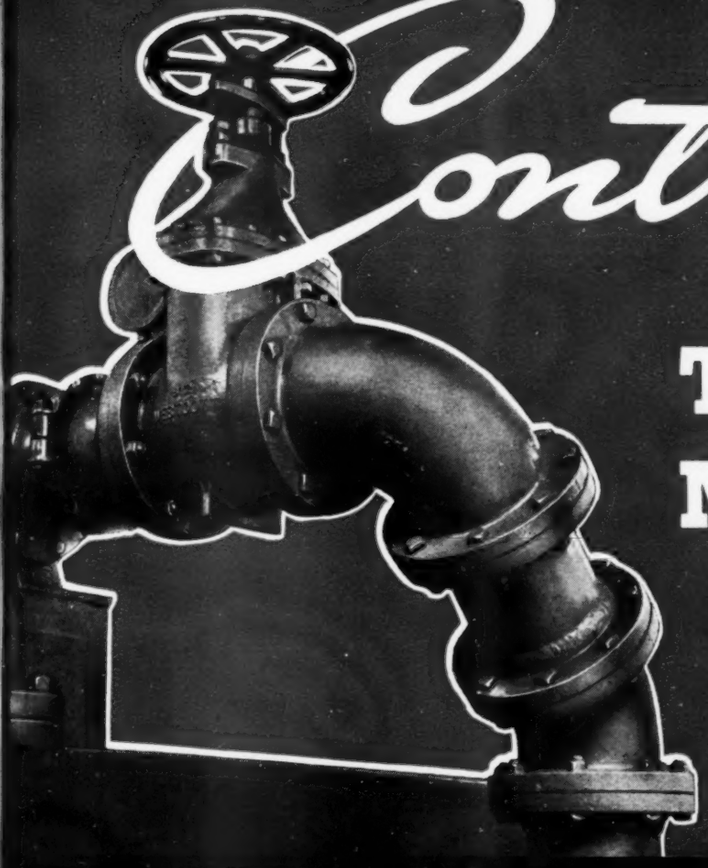
The demonstrations described have stressed the great force that may develop in a small quantity of gas and air when properly mixed. They have shown, also, that an inflammable mixture can be avoided by maintaining mixtures either above or below the inflammable limits. Some people wonder how an explosion of petroleum products can occur when there is no flame and no electric equipment is present to produce an arc to act as a source of ignition. There must be an ignition source, and the demonstrations have proved that a certain temperature must be reached and held for an interval of time before the ignition occurs. The time element is dependent upon the temperature and the combustible mixture.

Study of past explosions and of the many unusual, unexpected, or unthought-of ways an ignition source may develop indicates that the only 100-percent effective way of avoiding an explosion is to prevent formation of an inflammable mixture.

Static electricity is one of the least understood and probably the least predictable sources of ignition and for that reason presents many difficulties. Therefore, in coöperation with Paul Guest, electrical engineer, U. S. Bureau of Mines, Pittsburgh, Pennsylvania, the writer has developed a lecture and demonstration on static manifestations in the field. Static sparks intense enough to ignite explosive mixtures are generated by dropping water, by pouring mercury from one container to another, and by other means. Sparks can jump from tank to tank or between metal warehouses when a cloud passes over them and they are not properly grounded, though actual lightning is not manifested.

Conclusion

From the demonstrations described, it is self-evident that fire and explosions of petroleum gases are controlled by fundamental laws and therefore, in general, can be prevented by taking relatively simple precautions. If any one of the three elements—oxygen, combustible, or heat—is absent, if the



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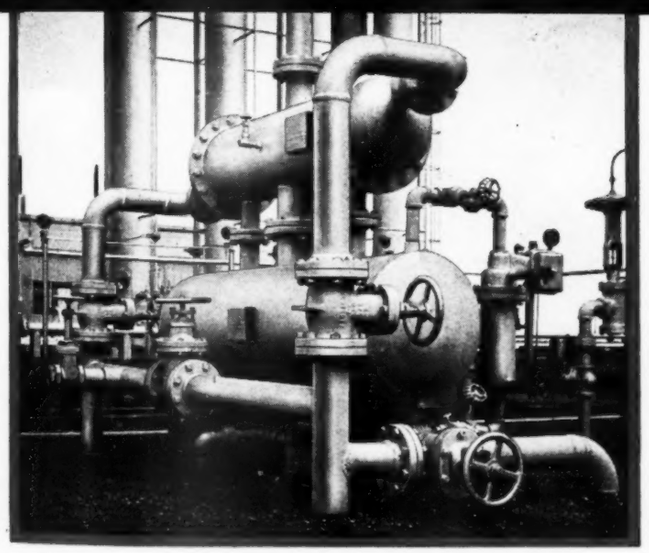

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gas and air are not within the inflammable limits, and if the heat is not intense enough, fire or explosion will not occur.

It was intended to stress the fact that an inflammable mixture can be ignited in so many different and frequently unforeseen ways that dependence for safety should be placed first on preventing the occurrence of an inflammable atmosphere when feasible, and, second, on preventing an ignition source. In buildings, in mines, and around petroleum plants or easily vaporized inflammable fluids, inflammable atmospheres can be avoided by depending on a positive ventilating current of air generated by mechanical means and not on natural ventilation.

The explosions in the horizontal tube demonstrated that manholes with loose covers or other types of openings should be provided at frequent intervals along refinery and city sewer lines to release the pressure developed by an explosion, thus assisting in preventing rupture of the line. The release of pressure does not prevent the explosion or flame from continuing on through the line.

The speed with which the flame or combustion travels through a sewer pipe or inflammable mixture depends on the ratio of combustible to air, the type of combustible, the direction of propagation, and other factors that cannot be demonstrated with equipment available.

This article has been confined to explosions and fires caused by a combination of carbonaceous substances and oxygen under conditions ordinarily encountered. It was not intended to include explosions caused by the combination of other substances, such as sodium and water and hydrogen and chlorine, although in many instances the fundamentals would apply.

Only the action of liquefied petroleum gases and methane was described. The reaction of many other gases, such as acetylene and hydrogen, under similar conditions would be so violent that they would probably shatter the glass demonstration equipment, endangering everyone present. Thus, one should not draw the conclusion from the discussion that he can predict exactly what will happen with all gas-air mixtures under all conditions.

The first line of defense against fires and explosions is to be sure that the workers know the characteristics of the products they handle and to eliminate, so far as possible, the conditions that might cause them. The second, and probably equally important, defense line is a crew of trained personnel who know what to do and have actually used fire-fighting apparatus and equipment.

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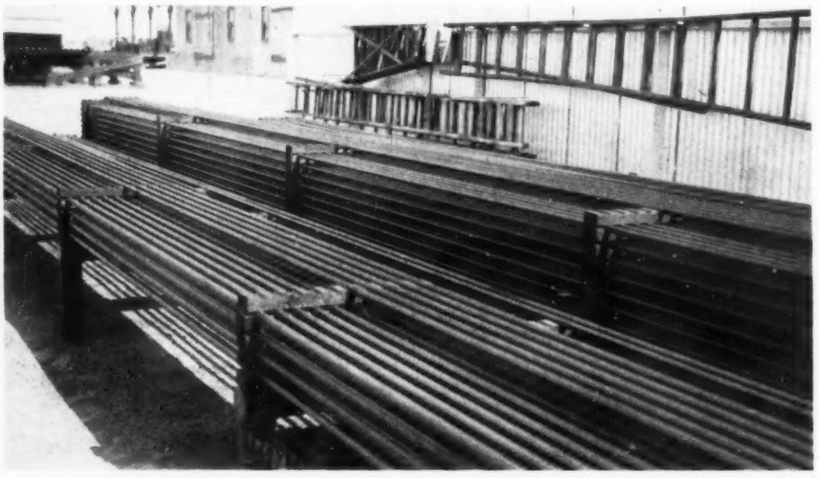
P 514.31

Protection of Sucker Rods

by J. C. Albright

IN AN area where soil, weather, and atmospheric conditions create a situation that causes most ferrous materials to deteriorate rapidly, one operating company constructs in its material yard special racks upon which to stack its supply of sucker rods. These racks are a permanent installation and are made by using junk pipe for leg risers placed in grouted holes, connected across the top by sections of pipe that are welded at the point of contact with the risers. The open ends of the cross members are closed with flat heads to prevent inside corrosion and to keep birds and small rodents from nesting. Across the top of each connecting member is bolted a chemically treated 2 by 4 recessed at regular intervals to receive individual rods, preventing metal-to-metal contact between cross members of the rack and the sucker rods.



Racks of sucker rods cleaned and oiled as protection against corrosion. Distortion is prevented by retainers adequately spaced on piers that provide ventilation between rods and the surface of the ground

The racks are of sufficient length to hold standard length rods stacked in layers of 14 units each. Rods to be placed in these stockpiles are thoroughly cleaned by wire-brushing the pins and boxes and are subsequently covered with heavy oil to exclude air and moisture from the threads. Each layer of rods is separated with cross-laid timber spacers that have receptacles cut in the upper face. The individual rods rest in these. At one end of the rack and beneath the stack of standard length rods, is a smaller rack in which subs and pony rods are racked above the ground level. The rod rack is placed at a point in the material yard convenient for a truck with rod-carrying equipment to be driven alongside for loading or unloading. By providing this type of storage, wells can be serviced quickly, as a single joint or a full string can be obtained on short notice, it not being necessary to clean boxes and pins, either in the yard or at the well.

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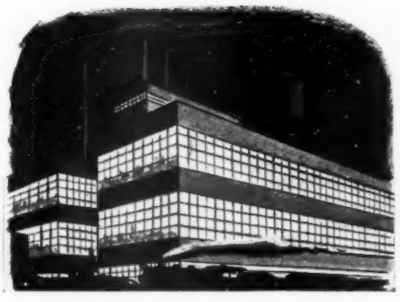
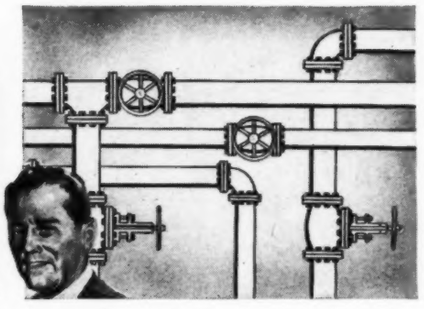
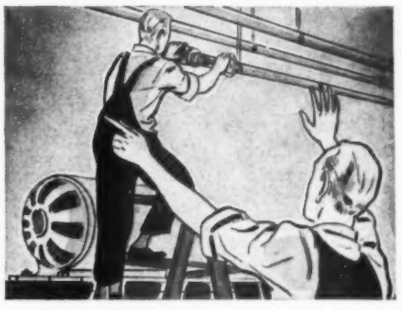
These "Pointers" Made a Tough Training Job Easier!



❶ With the plant running 168 hours a week, we needed more and better maintenance—day and night. On piping, for example, you can't get away with part-time maintenance and keep production lines running smoothly. It's too important!

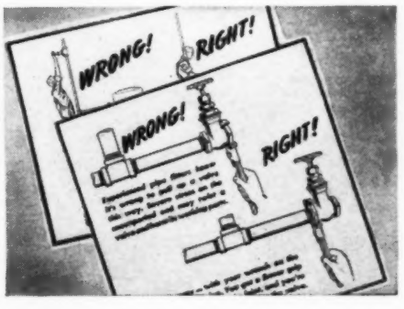


❷ Soon enough, we found valves and fittings would have to be handled with unusual care to get every last bit of service out of them. They're vital equipment, and with all the demands of war, deliveries of replacements were being slowed up.



❸ Sure, we put on more "maintenance" men, but many had never handled a wrench before. We had to start from scratch in training them. In the past, our veteran crews had the time to teach apprentices, but that was "before Pearl Harbor."

❹ You know that piping maintenance is a specialized job. But it's knowing the "kinks" of the trade that makes the difference between good and bad installations. They help speed-up the work as well as step-up efficiency of pipe lines.



❺ We had to teach these men the "rights and wrongs" of piping make-up. We had to be sure they knew enough about valves of all types, and when and where to use them. Good piping depends a lot on using the right equipment.

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Natural Gas—An Important Factor in California's Economy

☆ Value of natural gas production exceeded only by that of oil and gold

by Wallace A. Sawdon
Pacific Coast and Foreign Editor

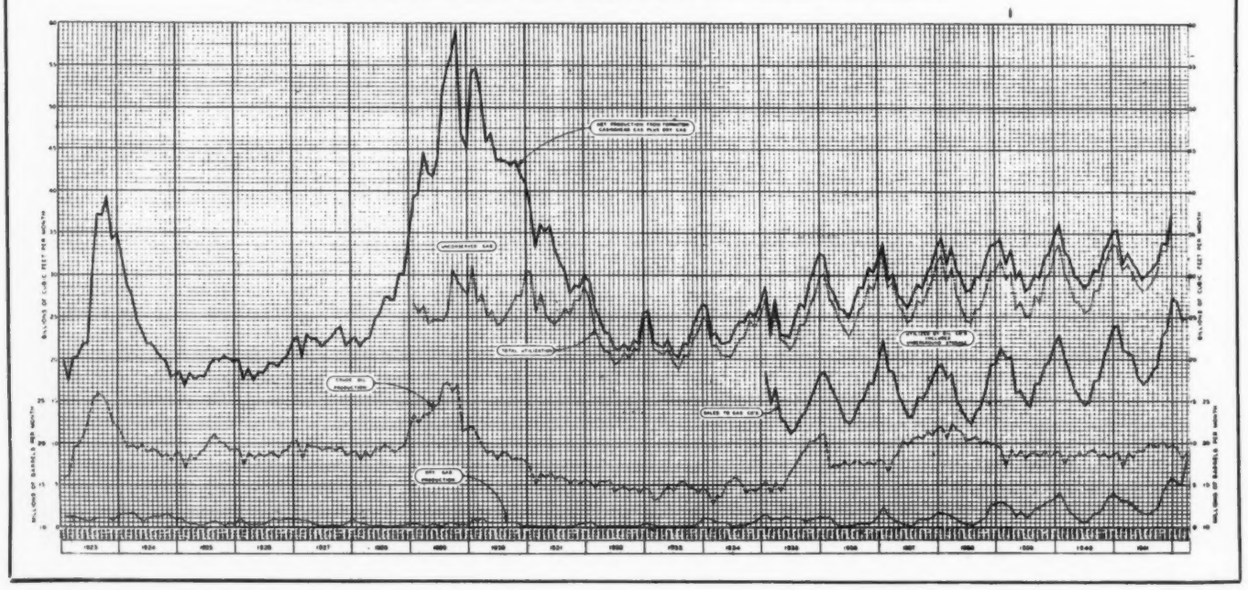
CALIFORNIA has a greater number of natural gas customers than any other state in the nation, is second in natural gas sales, and is the only large producing state that neither imports nor exports natural gas. The value of its natural gas production has been exceeded only by that of its oil and gold. Until recently, nearly all the natural gas used in the state was that from oil wells. It was not until 1939 that any considerable volume of dry gas from gas wells was taken; nor was it until about 1935 that much attention was paid to California's natural gas fields.

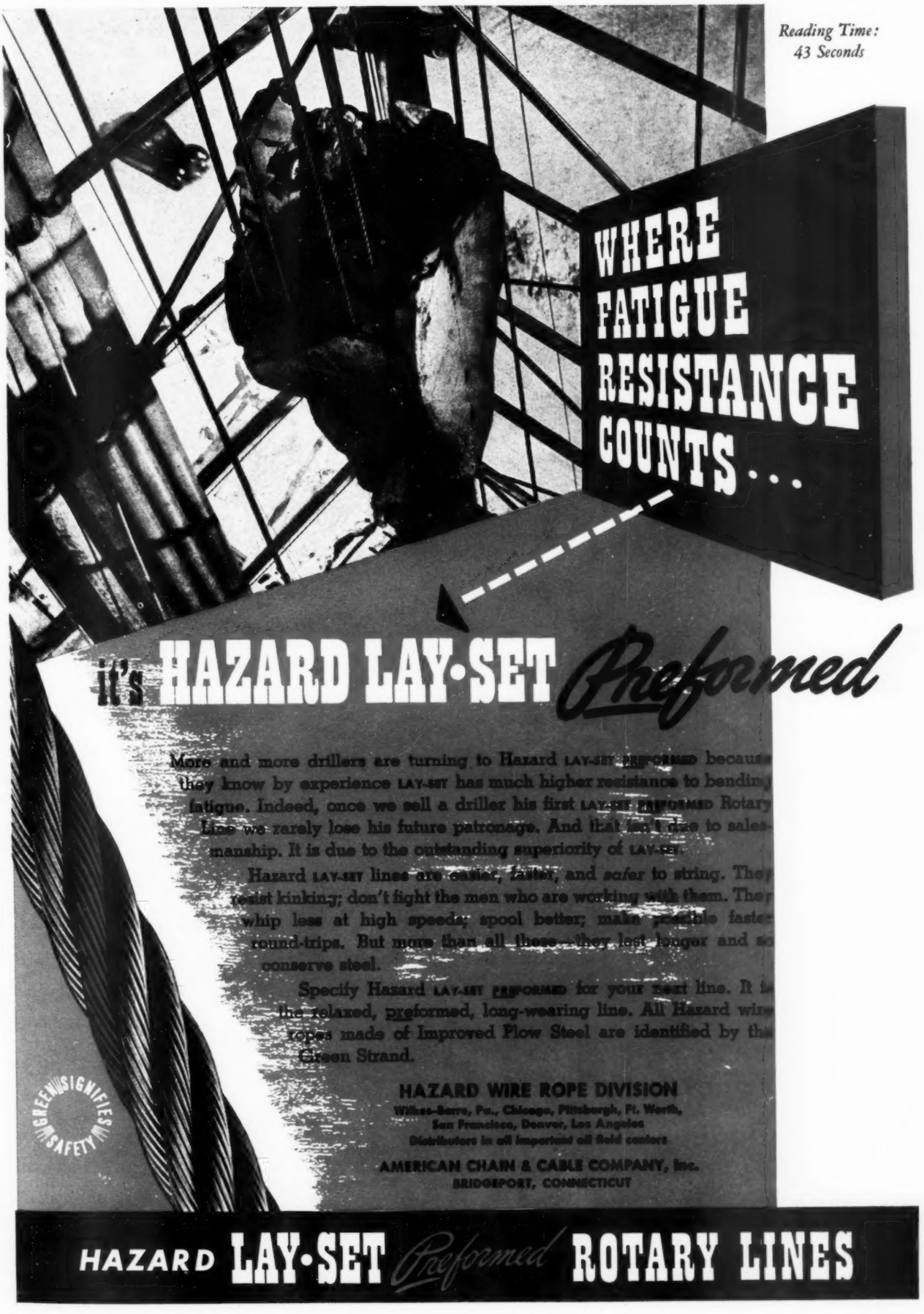
This almost total dependence on oil production for gas supply has naturally complicated the operations of the gas companies. Flexibility of supply is provided by dry gas fields that can be drawn on for peak loads when gas from oil wells may not be adequate. Until about 10 years ago, there was more than enough gas from oil wells to meet the demand and little dry gas was taken from gas fields, even during peak loads. During the last ten years, however, greater attention has been given to control of gas-oil ratios in the production of oil wells so the possibility of restricted gas production has obviously been given due consideration in a state where continuous growth has increased the demand for natural gas. This has resulted in more attention being given to the development of dry gas fields in greater utilization of gas from such fields as the demand has required. Yet production increases from gas fields have been very gradual and the total production has been increased to an appreciable extent only since 1939. This is indicated by Fig. 1, which shows the relative monthly production of crude oil and natural gas from 1923 to March of this year.

Dry Gas Use Increases

Although only little more than 9 percent of the total gas produced in California during 1941 was from dry gas fields, the amount of dry gas used during that year was the greatest in the history of the state. The use of dry gas will increase during the war due to the necessity of employing certain gas lines for the transportation of oil. The bulk of this dry gas is now coming from the Rio Vista field in Alameda County and is serving the San Francisco Bay area. By utilizing this gas in the Bay area it has been possible to release a large gas line (previously carrying gas from oil fields some distance to the south) for

Fig. 1. Monthly crude oil production, and natural gas production and utilization in California
(Courtesy Department of Petroleum Engineering, Southern California Gas Company)




Reading Time:
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WHERE FATIGUE RESISTANCE COUNTS . . .
it's HAZARD LAY-SET Preformed
More and more drillers are turning to Hazard LAY-SET PREFORMED because they know by experience LAY-SET has much higher resistance to bending fatigue. Indeed, once we sell a driller his first LAY-SET PREFORMED Rotary Line we rarely lose his future patronage. And that is due to salesmanship. It is due to the outstanding superiority of LAY-SET.
Hazard LAY-SET lines are easier, faster, and safer to string. They resist kinking; don't fight the men who are working with them. They whip less at high speeds; spool better; make possible faster round-trips. But more than all these—they last longer and so conserve steel.
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use in transporting oil to the refineries around the bay.

Status Gas Fields

The present status of California fields producing natural gas exclusively is as follows:

Gas fields	*Wells producing*	*Wells drilling*
Bowerbank	1	—
Buena Vista Lake	4	—
Buttonwillow	18	—
Delano	15	—
Fairfield Knolls	2	—
Goleta	5	—
Marysville Buttes	3	2
McDonald Island	7	—
Rio Vista	46	1
Semi-Tropic	3	—
Tompkins Hill	2	—
Tracy	4	—
Total	110	3

The gas from these fields is particularly important at the present time. The state is almost dependent on natural gas for heating purposes and industry has come to rely largely on gas for its fuel. The vast war plants utilize gas and their supply of this fuel is essential although conversion to other kinds of fuel could be made, if necessary.

Although it is not yet, and probably will not be, a problem, the demand for heavy oil in California could have an effect on the supply of natural gas from oil wells if the production of light oil that supplies most of the gas was curtailed extensively by the demand for heavy oil, which produces much less gas. It appears at present, however, that the true heavy oil potential is not great enough to limit the production of light oil to the extent that the gas supply, augmented by production from gas fields, will be inadequate for even the increasing demands. All factors influencing the oil and gas economy of the state have to be considered, however, and this is naturally being given due attention. It also involves transportation of both oil and gas and has necessitated a study of existing pipe lines to procure maximum utilization of both for oil and gas service.

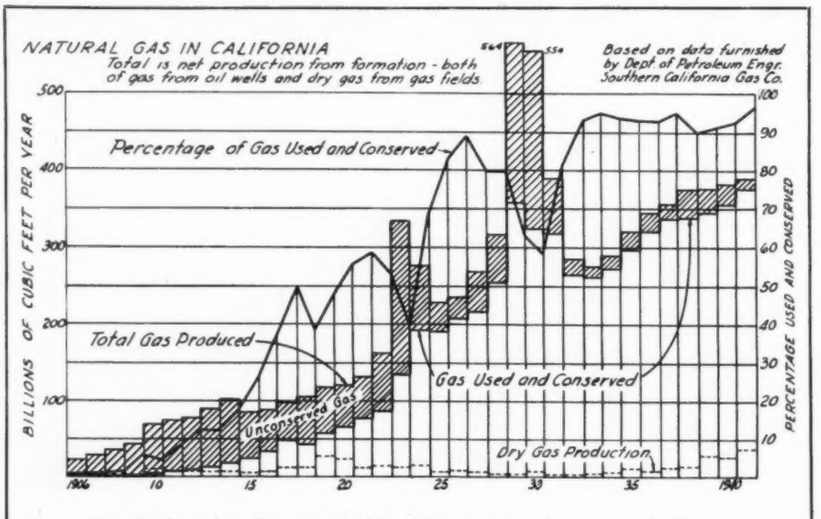

Fig. 2. Graphic data on California's gas production, utilization, and conservation

Gas Conserved

Of considerable interest has been the gradual reduction of waste of natural gas in the state. (See Fig. 2.) During the last ten years this waste has been reduced to such an extent that the utilization and conservation of natural gas has been 90 percent or more during that period. The greatest percentage of utilization and conservation was in 1941 when only 3.6 percent was not used or conserved. This degree of conservation will probably be maintained from now on, as there appears to be a trend toward the practice of returning excess gas to the formations for repressuring and storage. With the greater volume of gas available from fields producing gas exclusively there should be no need to disturb the gas-oil ratios that are determined as necessary for most efficient production, as any peak demands can be taken care of by the dry gas. The only problem that might arise is that of transportation.

The history of natural gas production and utilization in California is shown graphically in Fig. 2. The first natural gasoline plant was built in 1916 and the influence of this and of other plants that followed the conservation of gas is indicated by the curve showing the percentage of gas used and conserved. The effects of oil production peaks in 1923 and 1929 are also evident on this curve. The details of natural gas utilization during the last six years are given in Table 1.

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TABLE 1

Detail of natural gas utilization in California

(Compiled by Department of Petroleum Engineering, Southern California Gas Company)

	Volume in M. cu. ft.					
	1936	1937	1938	1939	1940	1941
Domestic and commercial	70,747,550	82,719,764	86,353,004	90,974,471	94,354,672	107,530,448
Industrial						
Field usage*	102,266,122	102,001,360	107,162,937	97,581,807	103,854,778	104,956,279
Underground storage†	1,377,000	1,589,000	2,144,000	5,918,000	6,287,000	
Oil company refineries and pump stations	34,815,564	37,317,066	38,862,448	22,149,357	22,527,049	23,696,055
Steam electric generating stations	21,266,668	15,548,648	9,176,686	22,545,362	13,440,590	12,072,740
Gas company own use	4,050,000	4,109,434	3,605,758	3,560,237	3,448,200	3,673,590
Other industrials**	74,043,391	80,398,620	78,162,762	86,879,662	95,284,070	109,512,113
Total industrial	237,818,745	240,964,128	239,114,591	238,634,425	244,841,687	253,910,777
Gas company unaccounted for	10,873,976	12,116,736	12,134,078	12,936,364	13,308,233	14,009,538
Total accounted for††	319,440,271	335,800,628	337,601,673	342,545,260	352,504,592	375,450,763
Total net production from formation	343,864,295	354,764,052	375,835,489	375,850,626	382,089,918	389,446,612

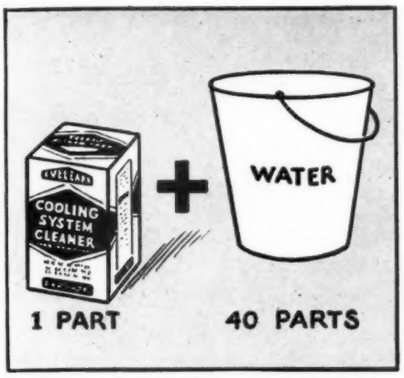
*–This is a balancing figure and includes field fuel (except gas used in cycling operations), drilling fuel, and gasoline plant shrinkage.

**–Includes gas-engine pumping, essential industrials, and surplus industrials.

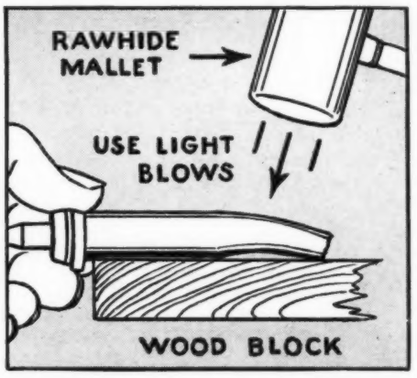
†–From U. S. B. M. Publications.

††–From S. D. N. R. Division of Oil and Gas Publications.

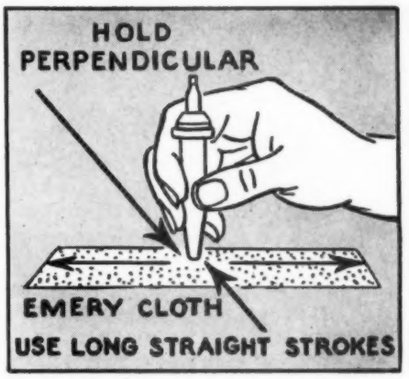
How to Recondition Oxy-Acetylene Hand-Cutting Nozzles



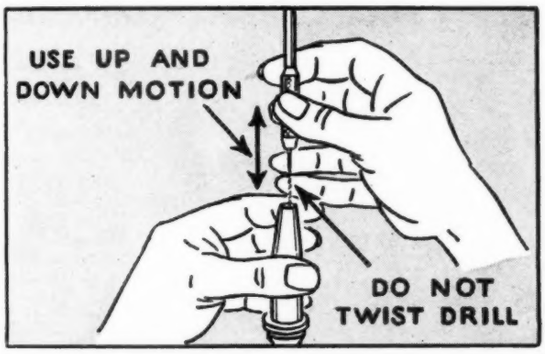
1. *Immerse the nozzle overnight* in a solution of 1 part "Eveready" automobile cooling system cleaning compound and 40 parts of water. Do not use the conditioner packed with the compound.



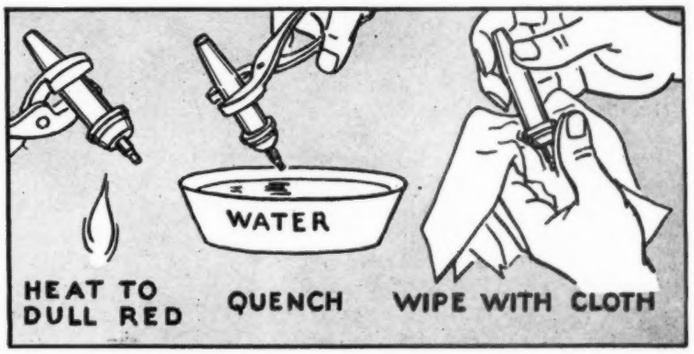
2. *If the nozzle is bent,* it usually can be straightened satisfactorily. To do this, place it on a wood block and straighten it by repeated light blows of a rawhide mallet. Do not use heavy blows.



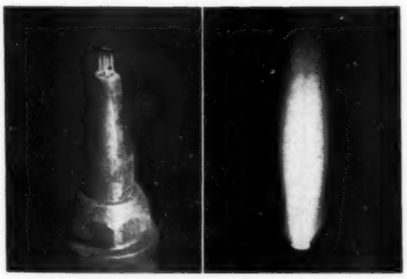
3. *Square Up the flame end* of the nozzle by rubbing it on Aloxite or emery cloth. Orifices must be round with sharp edges and no burrs. As much as ¼ in. can be removed from the nozzle end.



4. *To clear gas passages,* select the correct size drill—as specified in the blowpipe instruction book—and proceed as illustrated. Work the drill up and down carefully—do not twist it. If the drill does not enter the orifice easily, do not force it — start with smaller sizes. The last inch of the gas passages must be clean, to size, *and not bell-mouthed.*



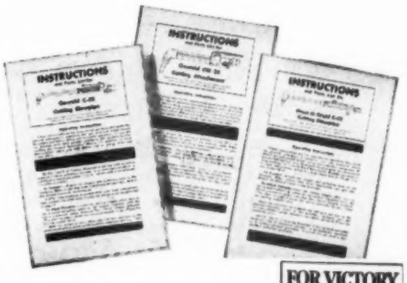
5. *To clean the nozzle seats,* heat up the seat end below the nozzle nut ring to a dull red heat—then quench in water. This loosens the scale so that it can be wiped off with a damp cloth. The heating softens the nozzle seats somewhat so that when connected to the blowpipe, they are burnished and dressed by the harder seating surfaces in the blowpipe head. If there are dents or nicks which are not eliminated by this procedure, the nozzle should be discarded.



6. *Test the flames.* Preheat flames should be uniform and the cutting oxygen jet symmetrical. Short preheat flames indicate restrictions in the gas passages. If the flames snap out when the valves are closed, the orifices are bell-mouthed.

Send for Instructions

If duplicate copies of the instruction booklets furnished with your Oxweld, Purox, or Prest-O-Weld apparatus will be helpful to you, we will send whatever copies you require. Be sure to specify the type of equipment you have. You may also obtain any required quantity of reprints of this advertisement.



THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd St., New York, N. Y. UCC Offices in Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," and "Prest-O-Weld" are trade-marks of Units of Union Carbide and Carbon Corporation.

Running Tour

WITH MEN IN THE INDUSTRY

J. E. BRANTLY, president of Drilling and Exploration Company, Inc., Los Angeles, California, and Dallas, Texas, has recently returned from Brazil, where he has been on business for the last several months.

E. A. GEBHARDT is now president of Commercial Advertising Agency, Inc., 600 South Michigan Avenue, Chicago, Illinois. He has been in the advertising business since 1906 and for the last eight years has been active in the affairs of the Chicago Industrial Advertising Association. He was a member of Industrial Marketing's Jury of Awards in 1940 and was recently appointed a director of the Chicago Central Lions Club.

WILLIAM M. BLACK was made vice-president of The American Brake Shoe and Foundry Company at a recent meeting of the board of directors, according to an announcement made by W. B. GIVEN, JR., president. Black retains his presidency of the American Manganese Steel Division of The American Brake Shoe and Foundry Company.

ROBERT W. COGHILL has been appointed senior petroleum analyst for the Board of Economic Warfare. He was formerly engineer with the Cooper Petroleum Company, Houston, Texas.

ROBERT T. KAIN, sales engineer in the belting department industrial products sales division of The B. F. Goodrich Company, has resigned to enter the United States Navy as a lieutenant, junior grade. He is a graduate of the Naval Academy at Annapolis, 1921.

L. H. (LARRY) CHENOWETH, manager, manufacturers' sales, in the industrial products sales division of The B. F. Goodrich Company, has been granted a leave of absence to serve on the Rubber Products Division of the War Production Board, according to an announcement by W. S. RICHARDSON, general manager of the division.

P. J. WILLIAMS has been transferred to Austin, Texas, as division superintendent for Shell Oil Company, Inc., Houston, Texas. He will replace W. B. SANDERS, transferred to the firm's Missouri division in the same capacity.

EDWARD V. OSBERG has been named vice-president in charge of all sales and technical service of the Wilmington Chemical Corporation, 10 East 40th Street, New York, New York. Osberg has a broad background in the rubber industry and has been a member of the editorial staff of *India Rubber World*.

JOE DRANGUET is now executive vice-president of the Lucey Petroleum Company, Dallas, Texas, according to an announcement by CAPT. J. F.

JOE DRANGUET

LUCEY, president. Dranguet's addition to the managing personnel completes the general expansion program of the company, which has been underway since Lucey's disposal of his interests in Talco Asphalt and Refining Company.

DR. G. D. HANNA has been appointed to the post of administrative assistant at the California Academy of Sciences in Golden Gate Park, San Francisco, where he will aid the director, DR. ROBERT C. MILLER in administration duties. He is widely known for his contribution to oil geology, micro-paleontology, and microscopic technique.

HARRY C. BEAVER has been elected president of Worthington-Gamon Meter Company to succeed the late E. T. FISHWICK. Beaver is also president of the Worthington Pump and Machinery Corporation. R. R. ANDERSON, treasurer and manager of Worthington-Gamon Company, has been elected vice-president and director, as well as retaining his office as treasurer.

R. L. BOSWORTH was recently chosen treasurer of the Continental Oil Company by the board of directors to succeed George F. Smith, who relinquished the treasurer's duties to devote his full time as vice-president to duties arising from the changes of the company to war-time policies. Bosworth has been office manager for the company in the New York office for the last nine years. He will be succeeded there by SERGE B. JURENEV, formerly with the United States Department of Justice, where he served as head of the research division.

EDWIN A. BOOTH became manager of sales for the Tulsa, Oklahoma, office of Spang Chalfant, Inc., July 1. He succeeds O. A. BERGMAN, resigned. Booth was formerly with the St. Louis, Missouri, office of the company.

CHARLES A. MABEY has been appointed director of research activities of The Bristol Company, Waterbury, Connecticut. Mabey has served as physicist for several years in the company. He is widely known in the research field.

J. J. HEALY, formerly with the Chicago, Illinois, office of the Copperweld Steel Company, is now a lieutenant in the United States Army Air Corps stationed at Field Point, Providence, Rhode Island.

DR. ELLIS E. JENSEN, executive director for Wisconsin of the National Conference of Christians and Jews for the last three years, has been employed as a research assistant in the industrial relations department of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, according to an announcement by LEE H. HILL, vice-president of the company.

THOMAS J. STEUART, assistant to the president of the Independent Petroleum Association of America, died July 7 in a hospital in Washington, D. C., from a lung illness. Steuart had been with the organization since 1931. He is survived by his widow, daughter, and two sons.

GREER W. ORTON, Nacogdoches, Texas, has been appointed by Petroleum Coördinator Harold L. Ickes as director of materials for the coördination office. Orton succeeds WILLIAM F. HUFF, who has been assigned to represent the coördinator in the formulation and application of a program to obtain maximum use of existing inventories of supplies and equipment now in the hands of oil companies and others. Huff has been in the employ of The Texas Company since 1928.

THE NEW STAR IS

WYTEFACE "A"!

Once again steel tapes have been improved—and by the same house that has led in measuring developments for the past three decades! This time it's WYTEFACE "A"—a new type of WYTEFACE Tape with *raised* black metal graduations on a crack-proof white surface; easy to read as a newspaper headline; with an uncanny resistance to abrasion that greatly prolongs its useful life. Constant wiping, abrasion with oil and sand, or scraping on the pipe pile have no terrors for this improved steel tape!

WYTEFACE "A" is the result of constant research. Less than thirty years ago all steel tapes were shiny—until K&E developed the well-known Keco finish to provide contrast for the numbers and graduations. In 1935 this same research produced the famous WYTEFACE line, with easy-to-read graduations marked directly on a crack-proof white surface. It is but one logical step to WYTEFACE "A" with its increased resistance to abrasion, designed particularly for oil field service!

There are K&E WYTEFACE "A" Steel Tapes in all sizes and types—in cases or on reels—for every job in the oil industry. You will find them stocked by every leading oil well supply company. Ask your dealer—or write for a catalog.

EST. 1867

KEUFFEL & ESSER CO.

NEW YORK • HOBOKEN, N. J.

CHICAGO • ST. LOUIS • SAN FRANCISCO • LOS ANGELES • DETROIT • MONTREAL

K&E

WYTEFACE "A"

TRADE MARK

STEEL TAPES

MELVIN MILLER, petroleum refinery engineer, Bell Oil and Gas Company, Tulsa, Oklahoma, recently prepared a nomograph on the subject of separating the oil from waste water for disposal in refineries. This nomograph was published on page 94 of the April, 1942, issue of *The Petroleum Engineer* as an illustration with an article by R. G. Lovell. Miller graduated from the University of Pittsburgh, Department of Petroleum Refinery Engineering, in 1938. Since that time he has worked for the Bell Oil and Gas Company under the direction of Dr. I. A. ANSON.

MELVIN MILLER

W. B. HEROY, petroleum geologist of Houston, Texas, has been appointed by Petroleum Coördinator Harold L. Ickes as director of the division of reserves in the coördinator's office. He succeeds E. DEGOLYER, recently named an assistant deputy petroleum coördinator.

ALBERT H. PIERCE has been appointed superintendent of the production department in the southern division, operating the southern half of Oklahoma, for the Mid-Continent Petroleum Corporation, with headquarters in Tulsa, Oklahoma, according to an announcement by GEORGE O. MOODY, vice-president for production. Pierce, formerly district superintendent at Seminole, Oklahoma, succeeds the late G. W. SHOWALTER. MARVIN RIGDON, formerly district foreman, Oklahoma City, Oklahoma, is assistant to Pierce and will have his headquarters in Seminole. ROY E. WINGO, formerly roustabout foreman at Seminole, succeeds Rigdon at Oklahoma City as district foreman.

W. A. PRICE has been elected president of the recently formed Corpus Christi Geological Society. Other officers include L. B. HERRING, vice-president, and C. I. JENNINGS, secretary and treasurer.

CHARLES B. JOHNSON, development engineer for the Seismograph Service Corporation of Tulsa, Oklahoma, is now in Venezuela, South America, in charge of well logging, according to a report by Gerald B. Westby, president of the company. Johnson was formerly associated with John T. Hayward and the Barnsdall Research Corporation.

G. B. PATTERSON, engineer for Socony-Vacuum Oil Company, Inc., specializing in aviation lubricants and hydraulic fluids, has received a commission as a major in the United States Army and has been assigned to active duty with the Air Corps, material division, Wright Field, Dayton, Ohio.

FRED (PETE) WALLACE, formerly manager of oil country sales of Link-Belt Company, with headquarters in Houston, Texas, has been transferred to the main plant in Indianapolis, Indiana. Wallace has been associated with the sales department of Link-Belt Company for the last 14 years and has represented the company in Oklahoma, New Mexico, Texas, Louisiana, and foreign fields. He is a member of the Nomads.

PETE WALLACE

OLIN CULBERSON, Texas Railroad Commissioner, has been formally designated by the commission as the Texas representative to the National Conference of Regulatory Authorities to succeed Commissioner Jerry Sadler. The group consists of representatives of the oil-producing states and was organized by the Office of Petroleum Coördinator to confer on matters pertaining to the industry.

W. A. DRAKE, gasoline plant superintendent at Flour Bluff near Corpus Christi, Texas, for the Humble Oil and Refining Company, has been transferred to the company's gasoline plant at Lirette as district gas superintendent.

AL KRAFT, formerly district superintendent at Drumright, Oklahoma, will succeed C. I. HOLLIMAN as assistant district superintendent for The Texas Company at Salem, Illinois. Holliman reported for duty in the United States Army July 1. He held a commission as first lieutenant. Kraft will be assistant to W. C. KNEALE, superintendent at Dallas, Texas.

FRANK E. OWENS, district petroleum engineer for Humble Oil and Refining Company, has been transferred from the Luling to the Stratton district.

C. R. RIDER, vice-president, Drilling and Exploration Company, Inc., is in Mexico City, Mexico, on a short trip.

FLOYD BRETT, formerly district superintendent for Sinclair Prairie Oil Company, Troup, Texas, has been transferred to Fort Worth, Texas, as assistant division superintendent of production.

D. C. HARMAN has been transferred from Houston, Texas, to Tulsa, Oklahoma, as division superintendent of the Stanolind Oil and Gas Company.

A. W. MACMURTRIE will assume the duties of W. D. MASON as plant manager of the Marcus Hook refinery of the Sun Oil Company while Mason is in Washington, D. C., as director of the Facility Security Division of OPC.

BOB HORTON has been appointed manager of oil country sales of Link-Belt Company with headquarters in Houston, Texas. Horton has been associated with Link-Belt Company for the last seven years as oil country sales representative, covering the entire Gulf Coast and southern districts. In his new capacity he will serve the Mid-Continent and Rocky Mountain districts. He is a member of the Nomads.

BOB HORTON

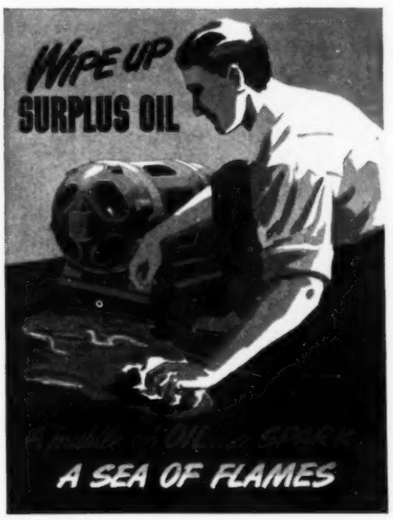
FIGHTING FIRES before they start

Most fires are preventable. A smoldering cigarette, flipped carelessly into a dark corner . . . a welder's spark flying unnoticed into a pile of oily waste—these little things can, and do, start devastating fires.

At the beginning of the war emergency, recognizing that fire is a treacherous and deadly saboteur of production, Bethlehem intensified its attack on the fire hazard. As always, trained, fully-equipped fire-fighting forces supplied the backbone of the fire-control effort, maintaining day-and-night vigilance in every Bethlehem plant and shipyard.

But to bring home the vital importance of fire prevention and control to every Bethlehem employee, we've designed a series of posters in full color and are displaying them in key locations throughout all Bethlehem shipyards and steel plants, which are now engaged in vital war work.

These posters are based on analysis of the most serious causes of fire and the all-important part of the human element in fire prevention. By pointing out to employees specific ways in which they can prevent or subdue fires, the posters are helping to minimize a potentially grave threat to the production of war materials.



Five of Bethlehem's series of fire-prevention posters. These posters are printed in full color. Each poster is designed to emphasize a specific problem in fire prevention or control.

BETHLEHEM STEEL

War-production plant executives who are carrying on fire-prevention campaigns may find these posters of interest. A complimentary set will be supplied on request to Bethlehem Steel Company, Bethlehem, Pa.

LAUGH WITH BARNEY

"Did you hear about the victory cat?"

"He worked on defense all night."

✦ ✦ ✦

And then there's the Scotsman who took his girl to the beach and told her shady stories so he wouldn't have to rent an umbrella.

✦ ✦ ✦

Her: How did you like the bridge party last night?

Him: It was fine until the cops looked under the bridge.

✦ ✦ ✦

1st Rousty: I hear the farm boss is back in the hospital.

2nd Rousty: Yeah he took a sudden turn for the nurse.

✦ ✦ ✦

Professor (sternly): When the room settles down I will begin the lecture.

Student: Why don't you go home and sleep it off?

✦ ✦ ✦

A very nice old English lady had a few words to say to her granddaughter.

"My dear," said the old lady, "I wish you would do something for me. I wish you would promise me never to use two words. One is swell and the other is lousy. Would you promise me that?"

"Why, sure, Granny," said the girl. "What are the words?"

✦ ✦ ✦

An office manager was telling how a girl came in to apply for a job, and when asked if she had any particular qualifications or unusual talents, stated that she had won several prizes in crossword puzzle and slogan writing contests.

"Sounds good," this fellow told her, "but we want somebody who will be smart during office hours."

"Oh," she exclaimed. "This was during office hours."

✦ ✦ ✦

Roses are red,
Violets are blue,
Sugar is sweet, wasn't it?

✦ ✦ ✦

The Young Man: What time is it getting to be?

The Young Lady: I don't know, but it was Saturday night when you came.

✦ ✦ ✦

The major menaces on the highway are drunken driving, uncontrolled thumbing and indiscriminate spooning. To put it briefly: hic, hike and hug.

Why do mice have more fun than anybody?

Because there are more of them! And there are more of them because they have more fun.

✦ ✦ ✦

We know a 5-year-old daughter who gave her mother the works about "life." Finally and completely mother told the whole story to which the daughter replied, "I was just wondering. Nancy Ann says she came from Houston."

✦ ✦ ✦

A man on trial for his life was being examined by a group of alienists. Suddenly one doctor jumped up and shouted to him: "Quick, how many feet has a centipede?" The man came back in a dry, dry voice: "Gad, is that all you have to worry about?"

✦ ✦ ✦

A professor was giving his class an oral quiz and picked upon a particular unfortunate specimen for his most difficult queries.

"Who signed the Magna Charta?"

No answer.

Who was Bonny Prince Charley?"

No answer.

"Where were you on Friday?"

"Drinking beer with a friend of mine."

"How do you expect to pass this course if you drink beer when you should be in class?"

"I don't sir—I only came in to fix the radiator."

✦ ✦ ✦

Wifey: Marie, don't you think my husband is a dimwit?"

Marie: Oui, madame, he ees veree amusing in ze dark!"

✦ ✦ ✦

Handsome: Can you read my mind?

Beautiful: Yes.

Handsome: Go ahead.

Beautiful: No, you go ahead!

✦ ✦ ✦

"Ralph, I thought that the doctor told you to stop all drinks."

"So what? You don't see many getting past me, do you?"

✦ ✦ ✦

Said the little calf to the silo: "Is my fodder in there?"

✦ ✦ ✦

"My, isn't a night club a great place on a rainy night?"

"You said it! Stay outside and get wet and come inside and get soaked."

Government Reports

Gentlemen:

With all of the new taxes, reports and regulations, I think I need a couple of stenographers and an extra typist, preferably ones who have passed Federal examinations, in order to keep check on permits, licenses and penalties. I overlooked one recently which made me feel like the farmer who lost his chewing gum in the hen house and thought he found it three times. Yours truly, U. G. Holt, Holt Drug Store, Bluffdale, Texas.—*Southern Pharmaceutical Journal.*

✦ ✦ ✦

Why take life seriously? You never get out of it alive.

✦ ✦ ✦

Cursing and yelling on a London street was Clancy holding a doorknob in his fist. "Them damn Nazis will pay for this—blowin' a saloon right out of me hand."

✦ ✦ ✦

"I wish you'd type your poems before bringing them to me."

"Type them? Do you think I'd waste my time composing poems if I could type?"

✦ ✦ ✦

He grabbed me by my slender neck
I could not call or scream,
And dragged me to his dingy room
Where we could not be seen.
He tore away my flimsy wrap
And looked upon my form,
I was so cold and damp and chilled
While he was hot and warm.
His fev'rish lips he pressed to mine
I gave him ev'ry drop,
He drained me of my very self
I could not make him stop.
He made me what I am today
That's why you find me here,
A broken bottle thrown away . . .
That once was full of beer.

✦ ✦ ✦

Rusty says he's too broke to buy etchings so he always asks his girl friends to come up and see the handwriting on the wall.

✦ ✦ ✦

Mark Anthony: Where's Cleopatra?

Servant: In bed with appendicitis.

Mark: Hell's bells . . . is he back?

✦ ✦ ✦

Philosophy from the Men's Restroom: "We aim to please. You aim too, please."

✦ ✦ ✦

Mother: Really, daughter, you shouldn't go out with men that you have not been formally introduced to.

Daughter: But ma, what difference does it make—they both act the same way when you get out with them.

CUMMINS DIESEL SERVICE BUILT AROUND THE *Customer's Needs*

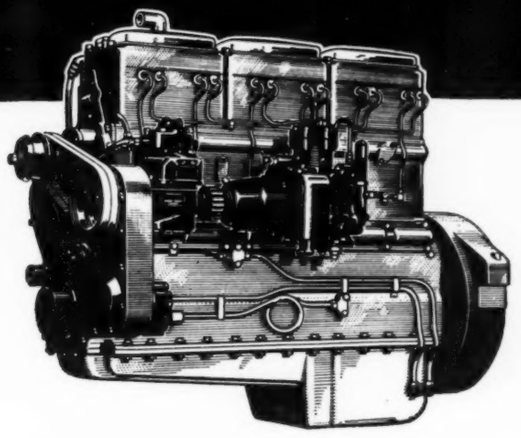
Who is better qualified to specify the kind of service he needs than the man who operates an engine? Who is better qualified to judge service than the owner?

That's why in 1933, the Cummins Customer Service Policy was built around the owner's needs . . . that's why it has continued on that same basis ever since.

One central parts stock at all major points reduces unnecessary duplication of parts . . . conserves the available supply. During the War, this is important.

Cummins was the first to establish this customer service policy . . . just as the Cummins Diesel was the first high speed, field-tested diesel to be accepted in heavy-duty, long line truck operations.

Today, Cummins Dependable Diesels are found in all branches of industry. They are doing their part in the War as standard power equipment for all kinds of dirt moving machinery and various other types of service. Their dependability and low cost operation are a matter of record in all types of heavy-duty work . . . automotive, industrial and marine. Cummins Engine Company, Columbus, Indiana.



MID-CONTINENT SUPPLY COMPANY

Distributors Mid-Continent Territory
FORT WORTH, TEXAS

MACHINERY and EQUIPMENT

BJ 300-Ton Elevator

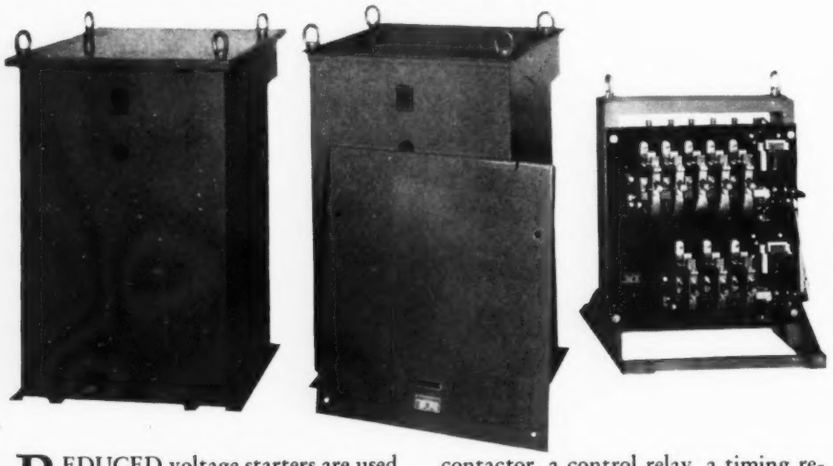
AN elevator to handle the longest, heaviest strings of 90-deg. shoulder-type drill pipe, is now available, according to the manufacturer: the BJ Type AA Elevator having a rated capacity of 300 tons, with a safety factor of four based upon the ultimate strength of the material.

The entire body of this new elevator is heat treated to withstand the terrific pounding effect of tool joints contacted at high speed when modern heavy-duty equipment is used.

All basic features of the BJ Center Latch Elevators are present in this 300-ton model: the body is constructed in halves of practically the same weight for proper balance and ease in opening or closing; the narrow width under the elevator trunnions permit the "Perfection Bend" on BJ Weldless Links to direct the lift under the tool joint or collar and minimize bending stresses; the long operating handles provide a man-size grip, with guards to keep the hands of the operator away from danger; curved link blocks allow greater freedom of the elevator links when operating the elevator, and these blocks are securely bolted to retain the links safely.

A new latch lock holds the Type AA Elevator latch closed and locked against accidental opening due to impact in the horizontal plane. Other details are available from Byron Jackson Company, Houston, Los Angeles, or New York.

Oil Immersed Reduced Voltage Starters



REDUCED voltage starters are used with a-c. squirrel-cage motors to limit the inrush starting current, or to reduce the strain on the driven machinery. The Class 431 Motor Starter is suitable for application in oil refineries, gasoline plants, pumping stations, etc., where explosion-resisting motor starters are desired, the manufacturer states. By means of an Auto Type Transformer the starting current demand is reduced, by reducing the voltage across the motor terminal during the accelerating period. The equipment is available in sizes from 5 to 500 hp. in 220, 440, and 2200 volts.

The Class 431 Oil Immersed Reduced Voltage Starter consists of a five-pole starting contactor, a three-pole running contactor, a control relay, a timing relay, overload protection, and a two-winding auto-transformer. The enclosure tank is of heavy gauge sheet steel, electrically welded. All equipment is mounted on the framework as a complete unit, and is easily removable from the tank. All parts of the unit are immersed under at least 6 in. of oil. An oil-level indicator mounted on the front of the enclosure tank shows the oil level at all times. It is floor mounted. Conduit connections are made through a conduit box mounted on the side of the enclosure tank.

Further information may be obtained from the manufacturers: Nelson Electric Manufacturing Company, 217 North Detroit, Tulsa, Oklahoma.

Flame Cutting Tips

TWO additions to their line of oxy-acetylene flame cutting tips have been announced by Air Reduction Sales Company. The first, known as Style 108, is ideal for working in close quarters, it is stated. It is bent in an offset shape, to permit cutting along a line 21/32 in. from the vertical centerline of the torch head or barrel. This offset design solves the problem of cutting close to bulkheads, flanges, or shoulders where the radius of the torch head would prevent alignment of the cutting orifice vertically over the desired line of cut.

The Style 108 tip has milled flat sides, with two preheat flames, and is suitable for either machine-cutting or hand-cutting operations. It is available at present in sizes Nos. 1 to 3, for cutting steel up to 1½ in. thick.

The other new addition to the line is the Style 139 straight tip with one preheat orifice, for certain machine or hand-cutting operations. This is a companion tip to the recently announced Style 119, which carries two preheat orifices. Made in sizes Nos. 0 to 3, Style 139 is particularly adapted to splitting angle-iron, straight-line cutting using a straight edge as a guide, or sheet-metal cutting operations, in which light preheat is desired.

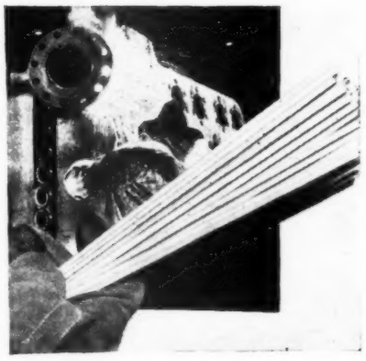
Further information about these or other tips in the Airco line may be obtained by writing to Air Reduction Sales Company, 60 East 42nd Street, New York, New York.

All-Position A-C. Arc-Welding Electrode

AN all-position, high-quality, a-c. electrode, Type W-26, extending the advantages and convenience of high-quality a-c. welding to both vertical and overhead positions, has been announced by the General Electric Company, Schenectady, New York.

Alternating-current arc-welding has already demonstrated its advantages for work in the horizontal and flat positions. The W-26, devoleped after intensive research, is for vertical and overhead a-c. welding.

Type W-26 electrode complies with the requirements of the following specifications: A.W.S. Filler Metal Specification E6011; Navy Bureau of Ships Specification 46E3, Grade 3, Class 1; and the A.S.M.E. Boiler Code, Paragraph U68.



By the use of this electrode, welding shops and fabricators, who have heretofore needed to supplement their a-c. welders with standby d-c. welders for high-quality work in the vertical and overhead positions, will now be able to release these machines for fabrication work where d-c. welding may be essential, the manufacturer asserts.

Type W-26 electrode compares favorably with the highest quality vertical and overhead welding characteristics available from reverse polarity d-c. electrodes. It provides a strong, forceful arc having good fusion, excellent penetration, and uniform characteristics free from arc blow, it is stated. It is now available in ⅛ in. and 5/32 in. diameters; other sizes from 1/16 in. to ¼ in. are expected to be available soon.

Welds made with this electrode of the 5/32 in. diameter show the following average physical properties, the data being obtained from all-weld-metal test specimens in the "as welded" condition:

Ultimate tensile strength	72,000 lb. per sq. in.
Yield point	60,000 lb. per sq. in.
Elongation in 2 in.	26 percent
Reduction of area	46 percent

OTIS WILL RUN YOUR TUBING, DRILL PIPE AND PACKERS *Under Pressure . . .*

Oil Industry, a - TEN - SHUN . . . don't ruin your producing wells with *Mud* or *Water* when you have tubing, drill pipe or Sub-Surface tools to run. OTIS can do this work *under pressure* with no danger to future production.

Ten years' experience on 6,079 wells is your assurance that the job can and will be well done.

Trained OTIS Service Crews are available for this work in every major field at a cost that is negligible compared to the loss of a producer.

Write for complete details and information

OTIS PRESSURE CONTROL, INC.
DALLAS, TEXAS

PRESSURE CONTROL OTIS SERVICE - EQUIPMENT

Branches: Houston, Texas; Hobbs, New Mexico; New Iberia, Louisiana
Representatives: Otis Eastern Service, Inc., Wellsville, New York; Western Pressure Control, Los Angeles and Bakersfield, California
Export Office: 74 Trinity Place, New York City

New Type Variable Pitch Cooling Fan

DEVELOPED primarily to control accurately the cooling water temperatures of industrial engines of the gasoline or Diesel types, Kontrol-Fan, Inc., Los Angeles, California, have announced a new type variable pitch fan that automatically draws more or less air through an engine radiator based upon the amount of cooling air required to maintain a predetermined temperature. Entirely automatic in its operation, the Kontrol-Fan blade assemblies function similarly to the variable-pitch propellers that are standard on all military aircraft—in that the blades feather from practically zero pitch up to as much as 38 deg. pitch. In this manner, the air flow through the conventional radiator is varied in accordance with the amount of cooling that is required.

Cooling fans produced by the firm, of the variable pitch type, have been in operation for a number of years, but previous models have not incorporated the positive pitch control feature that is now a part of their newest model. An unusual thermostat tube is placed between the water outlet on the cylinder head and the top of the radiator, using part of the existing hose connection. A sylphon bellows expands or contracts in accordance with the temperature of the cooling water, and through a simple lever arrangement the bellows actuate the fan blade angle between the minimum and maximum pitch angles. Thus a predetermined temperature can be maintained regardless of winter or summer conditions, or the load placed upon the engine.

Economies resulting from use of the Kontrol-Fan include reduced lubricating oil consumption, reduced power absorbed by the fan during its low or partial pitch operations, reduced crankcase sludging, and reduced engine repairs, according to the manufacturer.

Chlorine Substitute

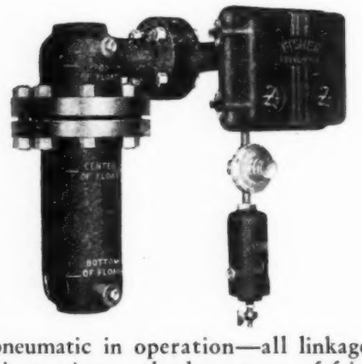
The Bettis Sales Company, Houston, Texas, recently introduced a germicidal compound to substitute for chlorine in the treatment of bacteria in drinking water and in sewerage systems.

The compound contains both mercury and oxide and has been developed especially to provide a bacterial agent that can be easily controlled and safely handled.

The germicide is available in liquid form in 5-, 10-, and 55-gal. quantities.

Improved Fisher Displacement Type Level-Trol

THE Fisher Governor Company, Marshalltown, Iowa, announces an improved Displacement Type Level-Trol that features greater sensitivity, speed of action, freedom from service trouble, and ease of adjustment. It is available in float cage or internal float type construction for handling all liquids at all pressures, temperatures, and specific gravities. Level-Trols can be used for level control, interface level control, level indication, or specific gravity control. The pilot is 100 percent



pneumatic in operation—all linkage, pivot points, and other sources of friction have been eliminated, reducing operating power to an absolute minimum. The pilot relay speeds action of the diaphragm valve in response to level change in vessel, resulting in extreme sensitivity control.

Level position adjustment permits the

COLMONOY SAVES VITAL METALS

The Pug Knives shown above tell a graphic story of the unusual wear resisting qualities of COLMONOY hard-surfacing alloys and overlay metals.

1. New, 24-pound pug knife, made of high alloy steel.
2 and 3. Same type, after only 3 months of service. Worn beyond efficient operation, with over half of blade material worn away.
4 and 5. Same type. Each blade coated with 1½ pounds of COLMONOY No. 6. In constant use for over a year, and still in efficient operation.

COLMONOY alloys are playing an important part in oil production and refining operations in the United States. Pump sleeves, plungers, rings, wash pipes and many other kinds of equipment used in the oil industry are particularly subject to excessive corrosion and abrasion.
COLMONOY keeps them on the job.

Write for Full Information

WALL-COLMONOY CORP.
Buhl Building, Detroit, Michigan

Branch Offices
NEW YORK CITY, BLASDELL, N. Y.; CHICAGO; TULSA; WHITTIER, CALIF.
Other branches in Canada

COLMONOY
Hard Surfacing Alloys and Overlay Metals

positive controlling of level at any desired point within the length of the float, and the throttling range adjustment makes it possible to vary the amount of level change necessary to stroke the diaphragm valve.

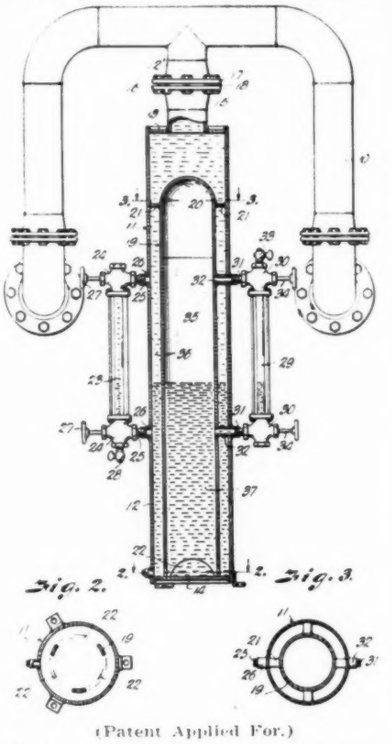
New design features include Inconel Torque Tube construction that eliminates stuffing-box packing and lubrication. The torque tube is supported by a stainless steel knife edge bearing that is free from gumming and sticking. A small rotary shaft turns on a precision-ground ball bearing inside the pilot case.

The stainless or plated carbon steel float is freely suspended, is free from lost motion, and entirely free from friction-causing guides. Float lengths are from 14 in. to 120 in. Fisher Level-Trols are available in five types.

The new Fisher Bulletin F-1 gives complete specifications, illustrations, pressures, and operating data. Address Fisher Governor Company, Marshalltown, Iowa.

Wheatley Liquid Seal Equalizer

A new pressure equalizer has been recently developed by Wheatley Bros. Pump and Valve Manufacturers, Tulsa, Oklahoma, for use on reciprocating pumps. Such a device is essential on



(Patent Applied For.)

the low pressure or suction side to absorb the momentum resulting from the constantly fluctuating velocity of the fluid, according to the manufacturers. Alleviators are also required on the high pressure or discharge side to equalize shock.

The Wheatley Liquid Seal Equalizer incorporates the best features of the conventional air chamber but eliminates the objectionable characteristics, it is asserted. The air or gas cannot escape into the line. This is because the sealing liquid is inert to absorption of air or gas from the compression chamber. The liquid is also insoluble in, and of higher specific gravity than, the liquid being pumped. These features minimize the tendencies toward corrosion and gum forming in the lines and totally eliminate the chance of explosion when air is used in the compression chamber, it is stated. This new alleviator has no moving parts and therefore no friction.

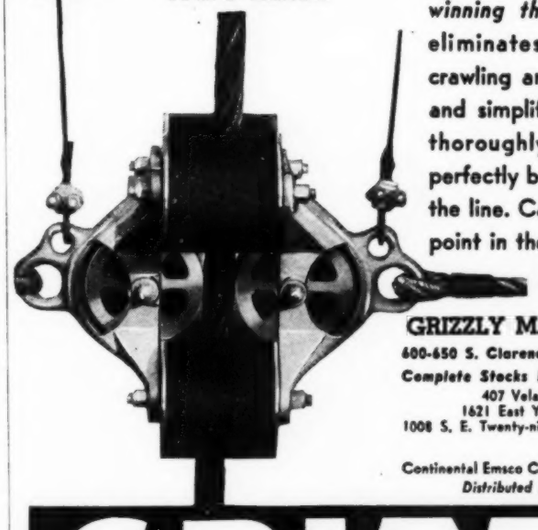
The new liquid seal alleviator may be used on both suction and discharge side. In high-pressure applications it may be necessary to charge the alleviator with gas when it is first set in the line. Periodic recharging is not necessary, however, because the Wheatley Alleviator does not lose its charge. The Wheatley Liquid Seal Equalizer may be used at all prevalent operating pressures of the petroleum pipe-line industry.

A thorough trial by a major pipe line has demonstrated the outstanding features and efficiency of the Wheatley Equalizer under actual operating conditions, the makers state.

Write for Bulletin No. CC424.

SAVE WIRE LINES and you Save Steel That is essential to War Purposes

Saves Miles Of Wire Lines



The Grizzly "No-Wip" Line Saver saves miles of wire lines every year . . . *thus conserving valuable steel that is essential to winning this war.* In addition, it eliminates whipping, prevents crawling and overlapping of lines, and simplifies proper spooling. A thoroughly engineered device, perfectly balanced, and floats with the line. Can be suspended at any point in the derrick.

Ask your supply dealer, or write for Bulletin No. 10-OF.

GRIZZLY MANUFACTURING CO.
600-650 S. Clarence St., Los Angeles, Calif., U. S. A.
Complete Stocks Maintained In Our Warehouse at:
407 Velasco Street, Houston, Texas
1621 East Yellowstone, Casper, Wyoming
1008 S. E. Twenty-ninth Street, Oklahoma City, Oklahoma
Export Office:
Continental Emsco Co., 30 Rockefeller Plaza, New York, N. Y.
Distributed by Leading Supply Companies

GRIZZLY
"NO-WIP" LINE SAVER

Self-Aligning Idler

CHAIN Belt Company, Milwaukee, Wisconsin, announces a new self-aligning idler for flat conveyor belts, both return and carrying, which help to keep the belt centralized on its supporting idlers, important for longest possible life from a conveyor belt.

The operation of this self-aligning idler is sensitive and instantaneous, it is stated. If for any reason the conveyor belt runs to one side it has a tendency to swivel the idler in a horizontal plane. If this in itself is not sufficient to cause the idler to swing enough to force the belt to throw back immediately, the belt will continue traveling to one side until it contacts the counterweighted end disk, which is slightly larger in diameter than the idler roll. Contact with the counterweight tends to rotate it, but as it is a counterweight it resists this tendency to rotate and produces a counterforce on the idler. This causes the idler to swivel rapidly, throwing the idler more out of line, which then immediately forces the belt to swing back the other way.

These Rex flat belt self-aligning idlers are sturdily built units, using the same principle of construction as the Rex self-aligning troughing idlers. No side guide rolls that impose unnecessary wear on the belt edge are used. When excessive misalignment of a conveyor belt exists, caused by such factors as stretch or weave in the belt, uneven loading of material on the belt, or shifting of the conveyor frame, Rex self-aligning idlers spaced at intervals between the stationary idlers will automatically bring the belt back to the central position, and avoid the possibility of serious injury to the conveyor belt, it is asserted.

Foxboro Hyper-Reset

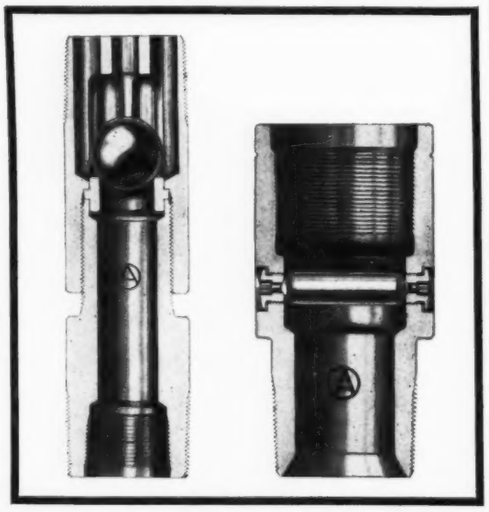
A NEW development of importance in the field of control engineering has been announced by The Foxboro Company, under the name of Hyper-Reset. This is not an instrument or a mechanism, but a control function, available in the newly-designed Model 30 Stabilog Controller, for application where process-lag is considerable. Its importance is demonstrated by tests in which Hyper-Reset consistently re-established process stabilization, following

an upset, in one-quarter of the time, and with only one-half the upset effect, as compared with a similar controller having only the usual reset, the manufacturer asserts.

Hyper-Reset reduces the effects of a process disturbance by making initial temporary additional corrections, which are proportional to the rates of change of the measured value caused by the disturbance. The normal reset follows, establishing stabilization. The several control functions carried out by Hyper-Reset are simultaneously and automatically adjusted. No tuning-in is necessary. No more than two process adjustments are required, proportional and Hyper-Reset.

The theory and performance of Hyper-Reset are fully explained in an attractive bulletin, No. A-330, just issued. Copies will be sent on request. Address The Foxboro Company, Foxboro, Massachusetts.

This AXELSON Combination is a time and money saver!



AXELSON 50th YEAR 1892 1942
THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

In certain fields, once you pull a pump, production doesn't immediately come back after the pump is re-run! To again pump fluid to a production level involves a needless drain on power unit. Particularly adaptable for low fluid level wells or "wet" wells is the combination of an Axelson Tubing Bleeder and Barrel Bottom Valve.

This combination prevents dumping back fluid into the well and thereby saving many hours of time in pumping fluid back to the surface. Another important feature is that if you want to bleed tubing after pulling the pump drop the "go devil," which knocks plug assembly from bleeder and fluid will then drain from 2 ports. The oversize capacity of the Barrel Bottom Valve allows large amounts of fluid to be handled in the tubing type pumps. Threaded joints, of extra length, insure greater rigidity and freedom from accidental loosening.

If you have a particular pump problem, *write Axelson today!* They will be pleased to supply you with complete information.

AXELSON MANUFACTURING CO., 6160 Boyle Ave. (P. O. Box 98, Vernon Sta.), Los Angeles, Calif.
Tulsa • St. Louis • New York City

AXELSON
SELLS AND SERVICES
OIL WELL PLUNGER PUMPS & SUCKER RODS

N. A. Endicott Appointed Sales Manager Continental Supply

The Continental Supply Company announces the appointment of N. A. Endicott as sales manager, effective July 1. Endicott will make his headquarters in Dallas, Texas.

N. A. ENDICOTT

Endicott is a veteran oil-field supply man. Except for a short time when he served in the army during the first World War, he has been with Continental for 26 years. He was vice-president of Continental Supply Company, Ltd., in Canada from 1929 to 1935 and has been active in the supply business in most of the United States' major fields.

C. G. Bonner Treasurer Pomona Pump Company

C. Granniss Bonner, formerly comptroller and more recently treasurer of The Brunswick-Balke-Collender Company of Chicago, has been elected treasurer of Pomona Pump Company, Pomona, California. Bonner relieves Donald C. McKenna, vice-president and former treasurer, who will devote full time to the increasing production activities of the company's four manufacturing plants. Pomona Pump Company is not only producing pumps for every direct and associated war effort, but also has undertaken a heavy schedule of marine engine and maritime fittings manufacture.

C. G. BONNER

Rockwell Heads A.G.A.E.M

Colonel W. F. Rockwell, president of Pittsburgh Equitable Meter Company and Merco Nordstrom Valve Company, who is now serving as Director of Production for the Maritime Commission in Washington, was recently elected president of the Association of Gas Appliance and Equipment Manufacturers.

During the few months in which he has devoted his principal attention to the production problems of the intensified shipbuilding program, Colonel Rockwell has been instrumental in accelerating the output of the shipyards to a point hitherto unequalled by any country in the world. According to Colonel Rockwell, U. S. shipyard production is now limited only by the capacity of the steel mills and not by the capacity of the shipbuilders. He further stated that in May more than 30 percent of the entire steel plate produced in this country was consumed in the tremendous Maritime program.

COL. W. F. ROCKWELL

In addition to Colonel Rockwell's duties with the Maritime Commission, he also serves as a member of the Executive Committee, Army and Navy Munitions Board and the War Production Board, Material Requirements Section.

Acting Secretary Natural Gas Section A.G.A.

Miss Honoria B. Moomaw has been appointed acting secretary of the Natural Gas Section of the American Gas Association, to succeed E. Holley Poe, secretary of the Section, resigned to become director of the Natural Gas and Natural Gasoline Division of the office of Petroleum Coördinator for War.

Miss Moomaw is a graduate of Randolph-Macon Woman's College, Lynchburg, Virginia, majoring in English. Her business experience includes retail and wholesale selling and sales promotion; several years as a medical secretary, and since 1939 secretary to Poe.

Hugh Aikman, J. H. Williams and Co. Executive, Dies

Hugh Aikman, secretary and publicity manager of J. H. Williams and Company, manufacturers of drop-forgings and drop-forged tools, died at his Buffalo home on June 20. Death came as a result of heart failure after an illness of seven weeks.

New York Nomads' Officers

Current officers of the New York Chapter of Nomads are shown in the accompanying photograph, as follows: Left to right, standing—John H. Baird, board of regents; J. A. Thomas, board of regents; A. V. Simonson, sergeant-at-arms; G. B. Flanigan, assistant sergeant-at-arms; C. J. DeLay, assistant secretary. Seated—F. J. Olson, treasurer; Val R. Wittich, Jr., secretary; Russel D. Heath, president, and I. Frank Brown, vice-president.

Superbly Located in NEW YORK CITY

At The Center Of

Major Attractions

A distinctive hotel—located in the heart of New York's finest shopping district—near the best theatres and gayest night clubs. In the hub of the City's social and cultural district, it offers an unusually central place to stay while in town. Here, spacious rooms, superb service, a quiet and refined atmosphere, and excellent cuisine, make for dignified living.

A. S. KIRKEBY
Managing Director

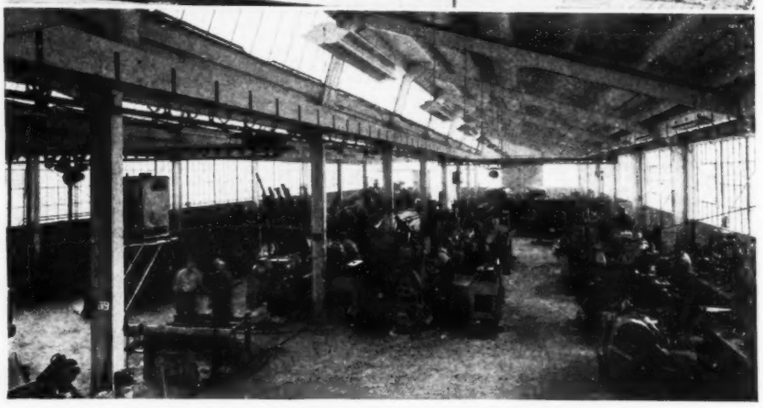
The Gotham
5th Avenue at 55th Street
NEW YORK CITY

McCullough Tool in New Building

A spacious new shop and office building now houses the Los Angeles headquarters of the McCullough Tool Company, 5820 South Alameda Street and Slauson Avenue.

The building is 60 ft. by 200 ft., of reinforced concrete construction, with offices at the front and the machine shop occupying the rear. The engineering department and laboratory are situated on a mezzanine floor above the offices.

Both the shop and offices are air-conditioned and provided with fluorescent lighting. Large windows are in all walls, and a newly developed type of roof structure provides excellent overhead lighting during the day.



J. H. Baird Export Representative for Unit Rig

Unit Rig and Equipment Company, Tulsa, Oklahoma, has announced the appointment of John H. Baird as export representative.

Baird has his headquarters at 420 Lexington Avenue, New York City, and represents a group of America's leading manufacturers of machinery, drilling tools, and production equipment for oil and gas wells. He is a prominent member of the Nomads and serves as secretary of the Board of Regents.

Hunt Tool Company Expands Houston Plant

Expanded plant of Hunt Tool Company

The Hunt Tool Company has just completed a building expansion program at its Houston, Texas, plant that included one new shop building, and the new modernistic office shown herewith. The new shop building houses complete facilities for reworking drawworks and other heavy pieces of oilfield equipment. Engineering, accounting and executive offices are housed in the new building, which is completely air-conditioned, plus other refinements.

The Navy "E" pennant is presented to Erastus B. Badger, president, by Captain W. D. Puleston, U. S. N. (Ret.). Front row, extreme right, is Governor Saltonstall of Massachusetts, who was the principal speaker

E. B. Badger Awarded Navy "E"

Before a large gathering of employees and their families, the Navy "E" for production achievement was awarded to E. B. Badger and Sons Company, industrial engineers, recently by Captain W. D. Puleston, U. S. N. (Ret.), representing the Secretary of the Navy.

Governor Leverett Saltonstall was the principal speaker at the ceremony, and commented on the contribution of Massachusetts labor and management to the war effort. Cambridge, site of the Badger plant, and Boston, home of the Badger offices for more than 100 years, were represented by Mayors John H. Corcoran and Maurice J. Tobin.

The award, and the responsibility to live up to the high standards of its tradition, were accepted on behalf of the company and its employees by Erastus B. Badger, the third member of his family to serve as president of the company.

Individual "E" lapel buttons were presented by Captain John J. Hyland, U. S. N. (Ret.), Inspector of Naval Materials, and were accepted by a committee of 17 employees, headed by John L. Allen, on behalf of employees. Subsequently buttons will be given to all employees of the company's Cambridge plant and Boston office.

The welcoming address was given by Charles E. Spencer, Jr., president and director First National Bank of Boston, representing Arthur D. Little, Inc., and the Massachusetts Institute of Technology.

E. H. Poe Heads New Division OPC

Appointment of E. Holley Poe as director of the newly-created Natural Gas and Natural Gasoline Division of the Office of Petroleum Coördinator for War has been announced by Petroleum Coördinator Harold L. Ickes.

Poe resigned as secretary of the Natural Gas Section of the American Gas Association to accept the appointment.

Standardization Program For Well Head Equipment Manufacturers

A long-range move, looking toward a permanent program of standarization of wellhead equipment, adoption of nomenclature, certified pressure testing, and other recommended practices, has been successfully projected by the Association of Well Head Equipment Manufacturers.

This program has resulted in adoption of specific terms and definitions applying to wellhead equipment, as well as a code of practices on the pressure-testing certification of wellhead equipment. In a further step, the association has officially adopted a monogram and seal both of which have specific purposes.

The association, in its field, benefits the equipment industry as a whole somewhat similar to the American Petroleum

AUTOMATIC

elimination and prevention of boiler scale and corrosion, economically and safely, while the boilers operate, by the use of SAND-BANUM.

Just add concentrated Sand-Banum to the feed water—only ounces once a week. Automatically it reaches and acts on the most inaccessible parts of the boiler. No need for water analyses or shut-downs.

"The Entirely Different Boiler and Engine Treatment."

Sand-Banum adds to life of boilers and tubes. Write for data.

AMERICAN SAND-BANUM COMPANY, Inc.

9 Rockefeller Plaza New York City

Look for the Arm and Hammer

ARMSTRONG BROS.

CHAIN TONGS

You can show lower tool cost if you standardize on ARMSTRONG BROS. CHAIN TONGS, for they have no "weakest link".

Jaws are drop forged from special steel, are hardened, tempered and tested for wearing qualities. Chains are proof-tested to two-thirds catalog strength (3,600 to 40,000 lbs.). Handles, shackles, bolts . . . tested steels, tested designs . . . Proven strength that will not fail, that will always stand up and give long, dependable service.

Write for Catalog C-39 showing improved Pipe Tools

"The Tool Holder People"

ARMSTRONG BROS. TOOL CO.

331 N. Francisco Ave., Chicago, U.S.A.

New York Warehouse & Sales:

199 Lafayette St., New York

Institute as it benefits the entire oil industry. Association standards are intended to govern the manufacture of wellhead equipment by providing greater interchangeability, more safety and economy.

By use of the A.W.H.E.M. standards, which are expected to be universally adopted by the manufacturers and users, economies and simplifications have resulted. Greater flexibility in use of these standards also has helped to effect suitable equipment. The standards were studied, formulated, and set up by experienced representatives of oil operators and manufacturers. Considerable analysis, investigation, and experimentation were conducted before final adoption. For instance, on October 19, 1941, the association adopted terms and definitions of wellhead equipment, which heretofore carried a hodgepodge of nomenclature. They are, in the order of their listing, as follows: casinghead, tubinghead, casing and tubing suspension, pressure sealing medium, Christmas tree, and blowout preventers. The casinghead and tubinghead are comprised essentially of the body, hanger, sealing medium, bonnet, and connecting means, the latter of which might be either flanged or threaded connections.

The code of recommended practices of pressure-testing certification, describing the proper use and significance of the monogram and seal, was adopted February 17, 1942.

The monogram and seal on wellhead equipment, already being used at present, is a guarantee of the manufacturer to the consumer that the material bearing the mark meets the A.W.H.E.M. specifications. The manufacturer is licensed to use the monogram or seal by filing a sworn statement that the material on which the monogram or seal is used meets the adopted specifications.

Further making them more important, the monogram or seal can be used only on materials that have been covered by A.W.H.E.M. specifications and then only in accord with the stipulations contained in the governing specifications under which authority to use the symbol has been granted.

Under the code of recommended practices on pressure testing and certification, the scope of the specification covers all materials defined in the terms and definitions of the Standardization Committee.

This latter specification is designed to cover minimum requirements and materials of equal or superior properties that may be substituted. For the time being, no chemical or physical properties are given, but the suggestion is made that specifications of the American Society for Testing Materials be used tentatively: (1) Cast-iron to be in accordance with specification A-126; (2) cast-steel to be in accordance with specification A-95; (3) forged-steel to be in accordance with specification A-105.

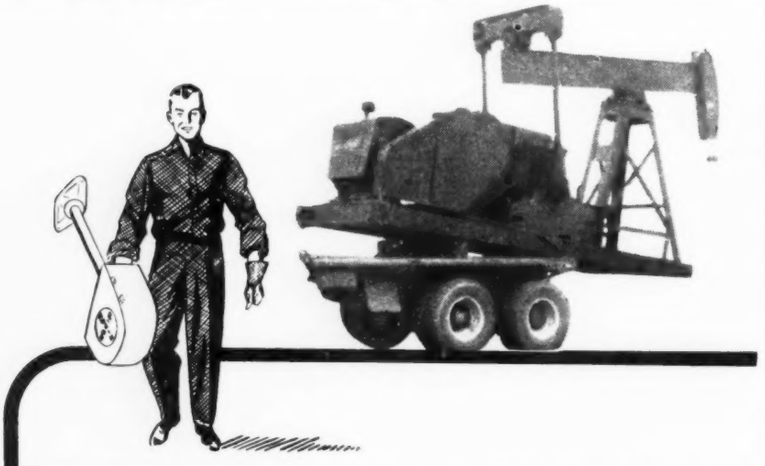
The materials covered by the certification are included in four groups, the first being steel castings used for working pressures of 1500 lb. per sq. in. and over, and forgings used for working pressures 1500 lb. per sq. in. and over. Under group two are included steel castings for working pressures from 500 lb. per sq. in. to 1500 lb. per sq. in., and forgings used for working pressures from 500 to 1500 lb. per sq. in.

Under group three, materials include steel castings or forgings used for working pressures from zero to 500 lb. per sq. in. Group four includes iron castings for working pressures from zero to 500 lb. per sq. in.

In testing, the testing pressure in general will equal two times the working pressure. A hydrostatic test with cold water is recommended as a testing fluid.

The association has supplied free copies of the standards and ideals to all purchasing agents, field superintendents, foremen, drillers, and others concerned with the purchasing or specifying of wellhead equipment.

The association maintains offices at Houston, Texas. Firms authorized to use A.W.H.E.M. symbols so far are: Beau-



POUNDS . . not tons of equipment

Nixon *Surface Control* Gas-Lift System

The small amount of equipment comprising the entire Nixon Gas-Lift System means:

1. **Large conservation of vital metals and machinery.**
2. **Quicker—cheaper installation since heavy hauling and heavy foundation construction are unnecessary.**
3. **Minimum operating cost.**
4. **Immediate availability of Units.**
5. **Production of restricted allowables at a profit due to low installation and maintenance cost.**

Have one of our engineers give you the complete story of Nixon Gas-Lift economy and efficiency. Write our nearest branch or sales office.

WILSON SUPPLY CO.

1412 Maury Street **Houston, Texas**

SALES OFFICES: Tulsa, Oklahoma; Dallas, Texas
LOS ANGELES: Western Pressure Control Co., 5700 Santa Fe Avenue
TRINIDAD, B.W.I.: Neal Massey Engineering Corporation

BRANCH STORES: TEXAS—Gladewater, Barbers Hill, Bay City, Monahans, Alice, Victoria, Corpus Christi. LOUISIANA—Lake Charles, New Iberia, Harvey, Shreveport

mont Iron Works, Beaumont, Texas; Brown Oil Tools, Inc., and Cameron Iron Works, Inc., both of Houston, Texas; Hinderliter Tool Company, Tulsa, Oklahoma; McEvoy Company and Oil Center Tool Company, both of Houston, Texas, and Rector Well Equipment Company, Inc., Fort Worth, Texas.

Appointments Announced By Kobe

Kobe, Incorporated, has announced the appointment of H. K. Ihrig as manager of the Tulsa District, and John Prichard as manager of the Illinois District.

Ihrig joined Kobe in 1940 after having spent several years in the development of special equipment for treating

H. K. IHRIG

JOHN PRICHARD

emulsified crude oil. After attending school at both the Missouri School of Mines and the Oklahoma A. and M. School of Engineering, Ihrig was successively employed in the petroleum engineering departments of the Wilcox Oil and Gas Company and the Phillips Petroleum Company. He will make his headquarters in the company's offices at 506 Kennedy Building, Tulsa.

After graduating from the Oklahoma University School of Petroleum Engineering, Prichard was for several years actively interested in various field problems of the oil industry, joining Kobe in 1940, later being made responsible for the company's operations in the Oklahoma City area. He will maintain his headquarters at the company's offices in Mount Vernon, Illinois.

T. Thorley and D. Waters Enter Armed Forces

Tom Thorley and David E. Waters, both of the Martin-Decker Corporation of Long Beach, California, have entered active service.

Thorley, a Martin-Decker engineer, was given a Lieutenant (j. g.) commission in the United States Navy and is at the U. S. Navy Training School at the University of Notre Dame. He entered the employ of Martin-Decker six years ago, coming from the University of Southern California.

Waters is now in the Ordnance Department of the U. S. Army, training at Aberdeen Proving Ground. He graduated from the University of Alabama and has been with Martin-Decker three years as one of the Mid-Continent factory representatives working with the Reed Roller Bit Company personnel.

PUMP TUBES and WORKING BARRELS

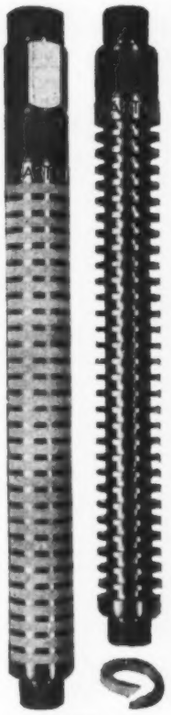
Last Longer . . . . . .

with MARTIN PLUNGERS

By using Martin Plungers, pump tube life is generally increased from 2 to 5 times. Only the Martin Resilient Rubber and Fabric Rings come in contact with the tube. These resilient rings cause far less wear than other plunger material.

Further important saving is effected by the Martin patented construction, which gives greater wearing life to the rings and bodies.

Write for Illustrated Catalog or See Composite Catalog



Patent No. RE-20574

SOLD ONLY THROUGH SUPPLY STORES

Only Martin Plungers have the one-piece "fluid-proof" bodies and "compensated" precision packing rings.

JOHN N. MARTIN
Manufacturer
11 W. Brady St. Tulsa, Okla.

Field Representatives:

Tom Hulett, El Dorado, Ark.
C. J. Baeten, Wichita, Kans.
Lynn C. Holloway, Houston, Tex.
Hugh Robinson, Blackwell, Okla.
F. M. Wilson, Wichita Falls, Tex.
E. C. Dilgarde, Casper, Wyo.
J. Walter Wade, Olney, Ill.

A SELF-LOCKING NUT
for every
IMPORTANT FASTENING

STANDARD-HEIGHT HEX NUTS
For all classes of bolted fastenings

THIN HEX NUTS
For shear bolts with light tensile load

ANCHOR NUTS
For riveting to structures

CLINCH NUTS
For insertion in sheet metal

Tight bolted fastenings go a long way toward keeping oil field equipment on the job. Ask for Elastic Stop Nuts on new equipment and use them for replacement on your present equipment.

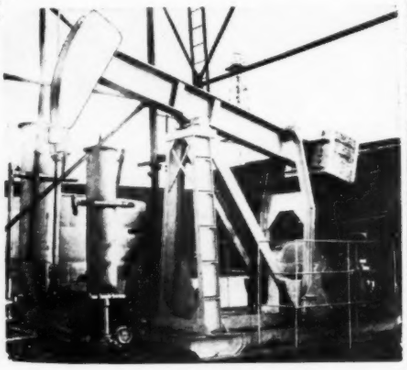
Your supply house has them . . . and factory stocks are maintained at Houston and Los Angeles.

» *Catalog on request* . . . and see data in Composite Catalog

ELASTIC STOP NUT CORPORATION
2365 VAUXHALL ROAD • UNION, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

You'll be Safer for the Duration with . . . . . JENSEN JACKS!



You don't want a greenhorn messing around with your wells. And, right now in particular, you don't want to be a party to experiments with pumping equipment. And so we want to remind you again that JENSEN JACKS are made by the oldest and largest exclusive manufacturer in the business. You can depend on a JENSEN, and parts will be available if they should be needed.

JENSEN
BROTHERS MFG. CO.
Coffeyville, Kansas, U. S. A.

Export Office: 50 CHURCH STREET, NEW YORK CITY

TRADE LITERATURE

What to Write For

A COMPLETE, but condensed catalog is offered by The Edward Valve and Manufacturing Company, Inc., 1592 West 145th Street, East Chicago, Indiana, on request. The catalog, No. 101, is entitled "Edward Better Valves," and describes and illustrates the Edward shut-off valve, stop valve, relief valve, blow-off efficiency valve, and Intex stop valve.

FULL INFORMATION is available on Colmonoy hard-surfacing alloys and overlay metals. Colmonoy alloys are used for pump sleeves, plungers, rings, wash pipes, and other equipment in the oil industry. Address Wall-Colmonoy Corporation, Buhl Building, Detroit, Michigan, for descriptive literature.

COPIES of the instruction books supplied with Oxweld, Purox, or Prest-O-Weld apparatus manufactured by The Linde Air Products Company, 30 East 42nd Street, New York, New York, will be sent on request. The booklets contain instruction material and notes on the care and use of equipment as well as repair notes to prolong useful operating life.

"THE PIPE OF PROGRESS" booklet will be sent on request by the Republic Steel Corporation, Cleveland, Ohio. It contains the story of the exclusive processes Republic employs in electric-weld casing, tubing, and line pipe.

KEUFFEL AND ESSER COMPANY, New York, New York, will send without obligation their catalog describing the Wyteface "A", raised graduations, steel tapes. According to the manufacture, the tape has excellent resistance to abrasion, and is designed particularly for oilfield service.

A CATALOG WILL BE SENT on request without obligation by the Elastic Stop Nut Corporation, 2365 Vauxhall Road, Union, New Jersey, manufacturers of "A self-locking nut for every important fastening."

WAR-PRODUCTION plant executives who are carrying on fire-prevention campaigns may find the complimentary set of posters offered by Bethlehem Steel Company, Bethlehem, Pennsylvania, of interest. The posters are printed in full color and each is designed to emphasize a specific problem in fire prevention or control. A complimentary set will be supplied on request.

FULL INFORMATION on the compact, high-capacity, antifriction Bantam Quill Bearings is offered in a bulletin that will be sent on request by Bantam Bearings Corporation, South Bend, Indiana. Ask for bulletin P-104.

HALLIBURTON OIL WELL CEMENTING COMPANY, Duncan, Oklahoma, now has available its new catalog, "Selective Acidizing." Complete description of all methods employed by the company in acidizing and acid drilling are included in the catalog. The catalog contains 16 pages of colored illustrations of tools and a description of each.

COPIES of the new Oil Well Supply Company, Dallas, Texas, bulletins are available on request. The seven new two-color bulletins of convenient, condensed form cover the entire line of Oilwell crown and traveling blocks for rotary drilling. B1-342, B2-342, and B3-542 describe the Nos. 250, 350, and 110 crown blocks, respectively. B4-542, B5-542, and B6-542 cover the 80-, 66-, and 60-in. streamline traveling blocks, respectively. B7-542 describes the 15-in. No. 200 crown block.

R. M. Cook Joins McCullough Tool

R. M. "BOB" COOK

R. M. (Bob) Cook, formerly vice-president of International Cementers, Inc., has joined the McCullough Tool Company, where he will be in charge of sales. Bob Cook is widely known in oil-field circles throughout the United States, for his activities have taken him into practically every active drilling and producing area for many years. He entered the oil tool business in the early days of the development of the Coalinga area, and was subsequently connected with Byron Jackson Company and Pacific Cementing Company.

While Cook will make his headquarters at Los Angeles for the present, he will spend much of his time in the districts served by the 16 McCullough branch offices.

Barber Shop Singers Hold National Contest

The petroleum industry was ably represented in the fourth national songfest of the Society for the Preservation and Encouragement of Barber Quartet Singing in America, held in Grand Rapids, Michigan, recently. Frank Thorne of Chicago, vice-president of the National Aluminate Corporation of which the Visco Products Company, Inc., is an affiliate, sang bass for the winning quartet, the Elastic Four. Other members of the group included Roy M. Frisby, James Doyle, and Herman Struble, all of Chicago, but not connected with the petroleum industry.

Taking third place was the Bartlesville Phillips 66 quartet. Harry Hall, Robert R. Duran, and H. E. Kaiser work for the Phillips Petroleum Company, Bartlesville, Oklahoma, whereas the other member of the quartet, George McCaslin, is an insurance man from Tulsa.

The fifth ranking quartet, the Chicago Misfits, includes among its members C. V. Perkins, Chicago advertising representative of *The Petroleum Engineer*. His associates consist of Peter Buckley, Art Bielan, and Joseph Murrin.

DeGolyer Assistant Deputy Co-ordinator

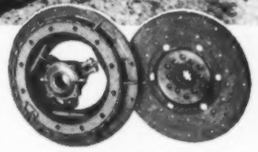
The appointment of E. DeGolyer, one of the world's outstanding petroleum geologists, as an Assistant Deputy Coördinator, was announced recently by the Office of Petroleum Coordinator for War Harold L. Ickes.

Since last July, DeGolyer has been the Office of Petroleum Coördinator's Director of Conservation. In private life, he makes his home at Dallas, Texas, and is an independent oil operator.

A geologist by training, the new assistant deputy coördinator was a pioneer in the introduction of geophysical methods into the art of prospecting for oil. For his achievements in this regard, he has been twice honored. He received the Anthony F. Lucas gold medal of the American Institute of Mining and Metallurgical Engineers in 1940, and, in 1941, was the recipient of the coveted John Fritz Medal awarded annually by the four great national engineering societies.

Rockford Clutches

Go Everywhere That Oil Does



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● From discovery to final use of petroleum products in gasoline or Diesel engines, Rockford Clutches have many applications. The two tractors on pipe line job illustrated each have a Rockford O-C Clutch in the main drive. Rockford Clutches in leading tractors, power units, and specialized oil field equipment promote reliable, efficient operation under all conditions. Whether you buy or build equipment, specify Rockford Clutches for superior results. Standard Over-Center and Spring-Loaded types cover a wide range of uses. Investigate also Rockford Power Take-Offs for S.A.E. housings. Complete information on request.

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Just circulate a solution of Oakite Compound No. 32 in unit or allow to "soak" for short period as directed, then neutralize and rinse. That's all! Insulating lime-scale and rust deposits are thoroughly removed without harming metal surfaces. Normal cooling efficiency is speedily restored. As a result, power is saved and operating cost lowered! FREE 24-page manual gives details. Write for it today!

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Twin Disc Moves Hydraulic Division

New machines and new facilities are now being installed in the Twin Disc Clutch Company's plant at 1310 Preston Street, Rockford, Illinois, and a considerable increase in the number of employees will take place very shortly, it has been announced. The expansion results from the creation of a separate division of the Twin Disc Clutch Company to handle the development, production, and sale of hydraulic drive and torque converters, formerly a department of the company's operations at Racine, Wisconsin.

R. M. Schaefer has been named vice-president in charge of the Hydraulic Division of the Twin Disc Clutch Company, all of the activities of which will be concentrated in Rockford. The products to be manufactured involve fluid-type transmissions. A considerable number of these units, which were previously produced in Racine, are now in service in a wide variety of equipment operating throughout the United States as well as in South America and Canada. Further engineering research and development will be carried on by the staff of Twin Disc engineers recently transferred from the Racine plant to the laboratories now made available in the Rockford plant.

As with most industrial concerns today, practically all the work of the Twin Disc Clutch Company is concerned with war production, and the new arrangement will speed up deliveries, both of hydraulic equipment and other products manufactured in Racine. In view of the increasing importance of hydraulic drives, a relatively new item, it is anticipated that peace-time needs will continue to demand all the production facilities now being established in Rockford.

P. H. Batten, one of the men who originally organized the Twin Disc Clutch Company in 1918, is extremely active as the president of the company in Racine, Wisconsin. Assisting Schaefer in Rockford will be R. P. Exten, plant manager, J. R. Murphy, purchasing agent, and R. T. Rehwald, assistant secretary of the company.

Maintenance Hints Notebook Now Available

To keep the tools of war industries in full operation, a two-volume set of maintenance rules and suggestions is now available to maintenance men concerned with the care of electrical apparatus in industry.

Written by engineers of the Westinghouse Electric and Manufacturing Company, the books total 220 pages and are made up of 15 chapters for loose-leaf insertion in 5-in. by 7-in. binders. Each chapter is brought up to date and additions will be made as conditions warrant.

Volume one covers inspection of electrical apparatus, insulation materials and applications, the cleaning, drying and testing of insulation, commutator maintenance, starting and regulating a-c., d-c., and squirrel-cage induction motors. All the necessary information for proper maintenance of insulation and motors is given with diagrams, tables, and charts to make the text easy to follow.

Volume two is devoted to contactor maintenance, the inspection of transformers, and a chapter on transformer connections. A number of wiring diagrams embrace all the more common connections for 2- and 3-phase, 25- and 60-cycle, power transmission.

Copies of maintenance hints notebooks are available to maintenance men from department 7-N-20, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

J. F. Pritchard Enlarges Its Service

J. F. Pritchard and Company, nationally known Kansas City engineering organization, recently has greatly enlarged its division of chemical design, engineering, and construction to meet growing requirements of the new petro-

W. W. DESCHNER

chemical industry. Dr. W. W. Deschner, formerly in charge of the Department of Chemical Engineering at the University of Kansas, is the active new head of this division.

The emphasis placed on petro-chemistry is directly due to the rapid developments in this field, according to officials of the Pritchard company. This organization long has been active in the petroleum, power, and natural gas fields in connection with the design and installation of compressor stations, dehydration plants, cycling and extraction plants, steam, Diesel, and gas power plants, cooling towers, and similar equipment.

Branch offices and representatives are maintained in industrial centers throughout the country.

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Bartlett Hayward Division Receives Navy "E"

Rear Admiral John H. Towers, U. S. N., chief of the United States Navy, Bureau of Aeronautics, headed a delegation of naval air officials from Washington to Baltimore recently to pay their respects to employees of Koppers Company, Bartlett Hayward Division, for the excellence and speed of their production of catapults for launching aircraft from navy vessels.

He presented the coveted Navy "E" burgee to the organization, the third such award to be made in this country on recommendation of the Naval Bureau of Aeronautics.

Rear Admiral Towers recently completed a mission to the British Isles where he was present during the organization and execution of the 1000-plane raids on Cologne and Essen, Germany, by the R. A. F.

Commander Calvin M. Bolster, U. S. N., awarded individual "E" lapel pins to Bartlett Hayward employees.

Seven thousand employees, members of their families, and other guests witnessed the impressive 30-minute ceremony on the plant property.

Before the ceremony there was an open house for employees and their guests. Exhibited were the naval catapults for which the award was made, 37 mm. and 40 mm. anti-aircraft gun carriages, and giant 25,500- and 35,550-lb. bronze propellers for Liberty ships and tankers of the Maritime Commission.

Governor Herbert R. O'Conor of Maryland and Mayor Howard W. Jackson of Baltimore were on the program. Frazier Hunt, radio commentator, was master of ceremonies. Walter F. Perkins, vice-president of Koppers Company and general manager of the Bartlett Hayward Division, received the burgee from Rear Admiral Towers in behalf of the employees.

Rear Admiral Towers has been active in naval aviation since 1911. He was one of the first three naval officers to be assigned to aviation duty. He commanded a unit of flying boats that, in 1919, made the first trans-Atlantic flight in the history of the world.

Ideco Announces New Sales Managers

The Industrial Products and Equipment Sales Department and the Oil Field Equipment Sales Department of International-Stacey Corporation, International Derrick and Equipment Division, have been combined and will be operated under the direction of W. Ferguson Barnes, general manager of sales, and J. M. Aitken, assistant general manager of sales, both having headquarters at Columbus, Ohio.

P. S. Graver Re-Appointed Chicago City Official

Phillip S. Graver, vice-president of Graver Tank and Manufacturing Company, Inc., Chicago, Illinois, has been re-appointed by Mayor Edward J. Kelly to a five-year term as a Commissioner

P. S. GRAVER

of the Chicago Park District. At the same time he was re-elected for the sixth consecutive time as vice-president of the Chicago Park District. Graver has long been active in this work, having recently completed his 14th year of association with the South Park Board of Commissioners and the Chicago Park District Board.

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MAKE PUMP MAINTENANCE EASIER
WESTCO PUMPS—now a Pomona-made product—have long been famous for the long life, low maintenance advantages of their renewable-liner design. Now this exclusive feature is even more vital, for it simplifies your pump problems under present emergency conditions...
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WESTCOS SAVE MONEY! They can be maintained at top efficiency by simply renewing the liners. Makes maintenance simple, quick... and saves 2/3 the cost of a new pump!
WESTCOS SAVE METAL! The renewable liners protect the pump case indefinitely against wear and corrosion. Renew just the liners to renew the pump. Saves metal vital to defense!
Every Westco is backed by the widespread facilities of an organization with 40 years' leadership in the pump field—your assurance of quick service, sustained satisfaction in your maintenance program.
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FOR POWER DRIVES ADVISE SERIAL NUMBER AND MOTOR CHARACTERISTICS.

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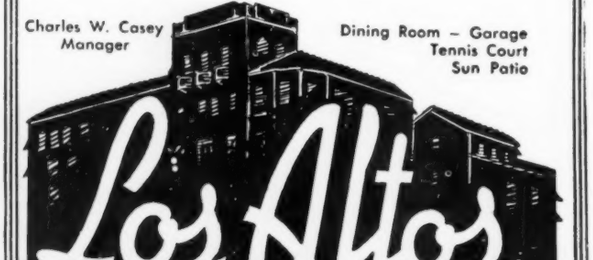

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Book Reviews

Lessons in Practical Arc Welding, by W. J. Chaffee. Published by Hobart Trade School, Inc. 188 pages. Paper cover. Price, 75c per copy; special prices to schools.

This book contains the complete series of 41 arc-welding lessons offered at the Hobart Trade School. Chapter headings include Preliminary Instructions; Starting and Manipulating the Arc; Welding Common Joints with Bare Electrodes; Welding Light Gauge Sheets with Coated Electrodes; General Welding with Coated Electrodes in the Flat—Horizontal—Vertical—Overhead Position; Pipe Welding; Welding Cast Iron; Special Practice and Tests. Text also contains a suggested classroom procedure and ready reference index.

The author has explained the fundamentals of arc welding in a simple and easily comprehensible manner.

Executives View Plant Expansion of Pacific Pump Works

To personally survey extensive plant expansion now completed by the Pacific Pump Works, Pacific executives and executives of the affiliated eastern companies met in Los Angeles, June 22. In this group were J. B. O'Connor, vice-president of Clark Bros. Co. and chairman of the board of directors of the Pacific Pump Works; C. P. Clark, president of Clark Bros. Co. and vice-president of the Dresser Corporation; A. R. Weis, president of the Pacific Pump Works, and Elmer Weis, vice-president of the Pacific organization. Pacific Pump Works and Clark Bros. Co. are affiliates of the Dresser Corporation, as is the Bryant Heater Company of Cleveland.

In speaking of the expansion work already completed, Clark, who is a director of Pacific, said: "Although we have already doubled the acreage covered by our Los Angeles plant, trebled the square footage of plant building, and quadrupled the number of employees, we plan to go even further if the War Production Board indicates that we can thus serve the United Nations better.

"Every affiliated plant is working on an all-out basis in producing materials for our war effort. It can truthfully be said that each concern is now 100 percent on war production and intends to continue on this basis for the duration."

From J. B. O'Connor came a statement of interest, having to do with sales and service efforts of the affiliated organizations. O'Connor said: "Since all our peace-time customers are now on war production work, where quick delivery is of the utmost importance, every effort is being made to supply them with needed products and materials whenever possible. Sales engineers and service men from each company are working with customers helping them to handle problems of maintenance and increased production volume.

"Our affiliated organizations are operating on the basis that every coupling, engine, or pump that can, through proper maintenance and service, be made to do for the duration, provides just that much more material and more man-hours for the production effort. Our many friends throughout the industry have been most understanding and coöperative in this connection."

From Los Angeles the executives' itinerary took them to San Francisco, the Pacific Northwest, and utlimately eastward.

A. F. Davis Recovered From Operation

A. F. Davis, vice-president of The Lincoln Electric Company, Cleveland, Ohio, was recently discharged from the hospital where he underwent an operation for appendicitis. He is back on the job and is coming along fine.

MEETINGS

Indiana Independent Petroleum Association, Fall Meeting—September 14 and 15.

National Petroleum Association, Annual Meeting—September 16, 17, and 18, Hotel Traymore, Atlantic City, New Jersey.

National Safety Congress and Exposition—October 5, 6, 7, 8, and 9, Stevens Hotel, Chicago, Illinois.

Texas Mid-Continent Oil and Gas Association—October 8, 9, and 10, Dallas, Texas.

American Society of Mechanical Engineers, Fall Meeting—October 12, 13, and 14, Rochester, New York.

Indiana Independent Petroleum Association—October 14 and 15, Hotel Severin, Indianapolis, Indiana.

National Stripper Well Association, Annual Meeting—October 19, Wichita, Kansas.

Independent Petroleum Association of America, 13th Annual Meeting—October 20, 21, and 22, Wichita, Kansas.

Illinois Mineral Industries Conference—October 30 and 31, Urbana, Illinois.

American Association of Petroleum Geologists—November 5 and 6, Los Angeles, California.

California Natural Gasoline Association—November 5 and 6, Los Angeles, California.

American Petroleum Institute, Annual Meeting—November 9, 10, 11, 12, and 13, Chicago, Illinois.

American Institute of Chemical Engineers, 35th Annual Meeting—November 16, 17, and 18, Netherland Plaza, Cincinnati, Ohio.

American Society of Mechanical Engineers, Annual Meeting—November 30 and December 1, 2, 3, and 4, New York, New York.

Union Wire Rope Awarded Navy "E"

The Union Rope Corporation, Kansas City, Missouri, is a recent member of the industry to be awarded the Naval "E" for Excellence in recognition of outstanding service to the war effort. The official presentation of the blue burgee was made in a ceremony at the Kansas City plant on Wednesday, July 8.

Rear Admiral W. C. Watts presented the blue banner to M. G. Ensinger, president of the corporation. John Haglein, the oldest employee of the company, accepted the "E" buttons for other employees.

Business leaders of the Kansas City area and a large delegation of Navy and Army officers were among the hundreds present. Distinguished guests included Captain S. C. Loomis, Inspector of Naval Materials for the Ninth Naval District; Commander D. W. Tomlinson; Mayor John B. Gage of Kansas City; Governor Payne Ratner of Kansas; Dwight H. Brown, Secretary of State for Missouri; R. H. Bartlett, Chairman of the Board of the Union Wire Rope Corporation; E. H. Reedy and Phil D. Morelock, Board members.

The Third Regiment band, American Legion color guards, and the fife and drum corps of the Northeast Youth Club added color to the occasion. Later in the day, a cocktail party and banquet were given by the Chamber of Commerce in honor of Union Wire Rope officials and distinguished visitors.

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Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Furnished with push-button faucet at slight additional cost)
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Large independent integrated company has opening for an experienced petroleum geophysicist with sound geological background and thorough knowledge of Mid-Continent area. The man wanted is of top calibre, capable of actively directing geological and exploration department. He is probably now profitably employed, but alert to an opportunity for immediate betterment and a future limited only by his ability to produce. Applications will be treated with strict confidence.

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